The PD SRM in R

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The standard PD SRM

Step 1: Read in your data.

Suppose you want to use a datafile called `data` which is located in the folder `datafolder`.

```
# Read in your data -------
  # Step 1a: Specify the path to your data
    setwd("C:\Users\laras\Documents\datafolder")
  # Step 1b: read in your data (only run line with the correct extension of your file)
      # for txt-files:
        mydata <- read.table("data.txt")
      # for csv-files
        mydata <- read.csv("data.csv")
      # for SPSS-files
        library(foreign)
        mydata <- read.spss("data.sav")
```

```
##   MF MO MY FO FY YO
## 1  5  6  6  5  5  6
## 2  5  5  5  4  5  6
## 3  6  6  5  6  5  7
## 4  3  6  6  3  3  6
## 5  6  6  6  6  6  7
## 6  6  6  6  6  6  6
```

```
  # Step 1c: take a look at the first lines of your data file
        head(mydata)
```

On top of the collumns, the variable names are displayed. Note that the variables in this data set are labelled as MF, MO, MY, FO, FY and YO. Here, `M` represents mother, `F` father, `Y` youngest child and `O` oldest child. These variable names are used in step 2.

Step 2: Specify the Purely Dyadic Social Relations Model.

Note that the following operators are used by lavaan for specifying your model:

- To specify the indicators (i.e., observed items) of each latent variable (i.e., PD SRM components) the operator =~is used. This operateor can be read as *is manifested by*
- To specify (residual) variances and covariances in the model syntax: ~~
- For defining intercepts: ~`label*1`
- == means *is equal to*
- > means *is larger than*

```
PDSRM <- '
  # Specify the indicators for each PD SRM component (cfr. Figure 3)
  # If you use other names for your variables, please adapt this in the following script
```

```
FC =~ lambdaMF*MF + lambdaMO*MO + lambdaMY*MY + lambdaFO*FO + lambdaFY*FY + lambdaYO*YO
I.M =~ 1*MF + 1*MO + 1*MY
I.F =~ 1*MF + 1*FO + 1*FY
I.O =~ 1*MO  + 1*FO + 1*YO
I.Y =~ 1*MY  + 1*FY + 1*YO
D.MF =~ 1*MF
D.MO =~ 1*MO
D.MY =~ 1*MY
D.FO =~ 1*FO
D.FY =~ 1*FY
D.OY =~ 1*YO

# Variances
FC ~~ VAR.FC*FC
I.M ~~ VAR.I.M*I.M
I.F ~~ VAR.I.F*I.F
I.O ~~ VAR.I.O*I.O
I.Y ~~ VAR.I.Y*I.Y
D.MF ~~ VAR.D.MF*D.MF
D.MO ~~ VAR.D.MO*D.MO
D.MY ~~ VAR.D.MY*D.MY
D.FO ~~ VAR.D.FO*D.FO
D.FY ~~ VAR.D.FY*D.FY
D.OY ~~ VAR.D.OY*D.OY

# Means
FC ~ mean.FC*1
I.M ~ mean.I.M*1
I.F ~ mean.I.F*1
I.O ~ mean.I.O*1
I.Y ~ mean.I.Y*1
D.MF ~ mean.D.MF*1
D.MO ~ mean.D.MO*1
D.MY ~ mean.D.MY*1
D.FO ~ mean.D.FO*1
D.FY ~ mean.D.FY*1
D.OY ~ mean.D.OY*1

# Constraints
mean.I.M + mean.I.F +  mean.I.O + mean.I.Y == 0
mean.D.MF + mean.D.MO + mean.D.MY == 0
mean.D.MF + mean.D.FO +  mean.D.FY == 0
mean.D.MY + mean.D.FY + mean.D.OY == 0
mean.D.MO + mean.D.FO + mean.D.OY == 0

# set constraints on factor loadings FC for identifiability
lambdaMF + lambdaMO + lambdaMY + lambdaFO + lambdaFY + lambdaYO == 6

# No negative variances are allowed (cfr. other software like EQS)
VAR.FC  > 0
VAR.I.M > 0
VAR.I.F > 0
VAR.I.O > 0
```

```
  VAR.I.Y > 0
  VAR.D.MF > 0
  VAR.D.MO > 0
  VAR.D.MY > 0
  VAR.D.FO > 0
  VAR.D.FY > 0
  VAR.D.OY > 0
'
```

If you are interested in calculating intragenerational similarities these can be requested by adding the following lines to the previous syntax:

```
I.M ~~ I.F
I.O ~~ I.Y
```

Note that when running this adapted model, you will have 3 (instead of 5) degrees of freedom left.

Step 3: Fit the model with your data and request the output

If you are using R for the first time on this device, please make sure to install the `lavaan` package first by running `install.packages("lavaan")`.

```
# load the lavaan package
  library(lavaan)
# fit the model with the data and ask a summary of the results
  fit <- lavaan(model = PDSRM, data = mydata, missing = "fiml")
  summary(fit, fit.measures = T)
```

```
## lavaan 0.6-3 ended normally after 458 iterations
##
##   Optimization method                           NLMINB
##   Number of free parameters                         28
##   Number of inequality constraints                  11
##
##   Number of observations                           106
##   Number of missing patterns                         5
##
##   Estimator                                         ML
##   Model Fit Test Statistic                       1.663
##   Degrees of freedom                                 5
##   P-value (Chi-square)                           0.894
##
## Model test baseline model:
##
##   Minimum Function Test Statistic              482.254
##   Degrees of freedom                                15
##   P-value                                        0.000
##
## User model versus baseline model:
##
##   Comparative Fit Index (CFI)                    1.000
##   Tucker-Lewis Index (TLI)                       1.021
##
## Loglikelihood and Information Criteria:
##
```

```
##   Loglikelihood user model (H0)                -641.787
##   Loglikelihood unrestricted model (H1)        -640.956
##
##   Number of free parameters                          22
##   Akaike (AIC)                                1327.574
##   Bayesian (BIC)                              1386.170
##   Sample-size adjusted Bayesian (BIC)         1316.664
##
## Root Mean Square Error of Approximation:
##
##   RMSEA                                          0.000
##   90 Percent Confidence Interval          0.000  0.060
##   P-value RMSEA <= 0.05                          0.936
##
## Standardized Root Mean Square Residual:
##
##   SRMR                                           0.015
##
## Parameter Estimates:
##
##   Information                                 Observed
##   Observed information based on                Hessian
##   Standard Errors                             Standard
##
## Latent Variables:
##                    Estimate  Std.Err  z-value  P(>|z|)
##   FC =~
##     MF      (lmMF)    0.573    0.117    4.903    0.000
##     MO      (lmMO)    1.068    0.086   12.349    0.000
##     MY      (lmMY)    1.278    0.099   12.907    0.000
##     FO      (lmFO)    1.163    0.075   15.578    0.000
##     FY      (lmFY)    1.166    0.083   14.092    0.000
##     YO      (lmYO)    0.753    0.106    7.100    0.000
##   I.M =~
##     MF                1.000
##     MO                1.000
##     MY                1.000
##   I.F =~
##     MF                1.000
##     FO                1.000
##     FY                1.000
##   I.O =~
##     MO                1.000
##     FO                1.000
##     YO                1.000
##   I.Y =~
##     MY                1.000
##     FY                1.000
##     YO                1.000
##   D.MF =~
##     MF                1.000
##   D.MO =~
##     MO                1.000
##   D.MY =~
```

```
##     MY                1.000
##   D.FO =~
##     FO                1.000
##   D.FY =~
##     FY                1.000
##   D.OY =~
##     YO                1.000
##
## Intercepts:
##                    Estimate  Std.Err  z-value  P(>|z|)
##     FC      (m.FC)    5.716    0.080   71.844    0.000
##     I.M    (m.I.M)    0.338    0.408    0.827    0.408
##     I.F    (m.I.F)    0.087    0.518    0.168    0.867
##     I.O    (m.I.O)    0.048    0.366    0.130    0.897
##     I.Y    (m.I.Y)   -0.472    0.328   -1.438    0.150
##     D.MF  (m.D.MF)    2.049    0.339    6.054    0.000
##     D.MO  (m.D.MO)   -0.727    0.232   -3.133    0.002
##     D.MY  (m.D.MY)   -1.322    0.240   -5.516    0.000
##     D.FO  (m.D.FO)   -1.322    0.240   -5.516    0.000
##     D.FY  (m.D.FY)   -0.727    0.232   -3.133    0.002
##     D.OY   (m.D.O)    2.049    0.339    6.054    0.000
##    .MF                0.000
##    .MO                0.000
##    .MY                0.000
##    .FO                0.000
##    .FY                0.000
##    .YO                0.000
##
## Variances:
##                    Estimate  Std.Err  z-value  P(>|z|)
##     FC     (VAR.F)    0.473    0.092    5.171    0.000
##     I.M  (VAR.I.M)    0.129    0.041    3.176    0.001
##     I.F  (VAR.I.F)    0.417    0.072    5.761    0.000
##     I.O  (VAR.I.O)    0.099    0.026    3.766    0.000
##     I.Y  (VAR.I.Y)    0.000       NA
##     D.M (VAR.D.MF)    0.261    0.079    3.288    0.001
##     D.M (VAR.D.MO)    0.168    0.044    3.850    0.000
##     D.M (VAR.D.MY)    0.063    0.052    1.210    0.226
##     D.F (VAR.D.FO)    0.045    0.032    1.429    0.153
##     D.F (VAR.D.FY)    0.094    0.032    2.942    0.003
##     D.O  (VAR.D.O)    0.473    0.074    6.385    0.000
##    .MF                0.000
##    .MO                0.000
##    .MY                0.000
##    .FO                0.000
##    .FY                0.000
##    .YO                0.000
##
## Constraints:
##                                                |Slack|
##     mean.I.M+mean.I.F+mean.I.O+mean.I.Y - 0      0.000
##     mean.D.MF+mean.D.MO+mean.D.MY - 0            0.000
##     mean.D.MF+mean.D.FO+mean.D.FY - 0            0.000
##     mean.D.MY+mean.D.FY+mean.D.OY - 0            0.000
```

```
##     mean.D.MO+mean.D.FO+mean.D.OY - 0            0.000
##     lmbdMF+lmbdMO+lmbdMY+lmbdFO+lmbdFY+YO-(6)    0.000
##     VAR.FC - 0                                   0.473
##     VAR.I.M - 0                                  0.129
##     VAR.I.F - 0                                  0.417
##     VAR.I.O - 0                                  0.099
##     VAR.I.Y - 0                                  0.000
##     VAR.D.MF - 0                                 0.261
##     VAR.D.MO - 0                                 0.168
##     VAR.D.MY - 0                                 0.063
##     VAR.D.FO - 0                                 0.045
##     VAR.D.FY - 0                                 0.094
##     VAR.D.OY - 0                                 0.473
```

Extending the Standard PD SRM

The standard PD SRM can be extended to investigate more complex research questions as well. This can easily be done by adding one line of code to the model. We will discuss two plausible extensions. First, one might want to test an hypotheses that involves the direct comparison of two PD SRM components. For example, for testing if mothers share more family meals with all family members than fathers do a new parameter can be defined. This is done by subtracting the two relevant components and checking if this new parameter differs significantly from zero (i.e., diff = mean.I.M - mean.I.F).

```
PDSRM3 <- paste0(PDSRM, 'diff := mean.I.M - mean.I.F' )
fit3 <- lavaan(model = PDSRM3, data = mydata, missing = "fiml")
summary(fit3, fit.measures = T)
```

```
## lavaan 0.6-3 ended normally after 458 iterations
##
##   Optimization method                           NLMINB
##   Number of free parameters                         28
##   Number of inequality constraints                  11
##
##   Number of observations                           106
##   Number of missing patterns                         5
##
##   Estimator                                         ML
##   Model Fit Test Statistic                       1.663
##   Degrees of freedom                                 5
##   P-value (Chi-square)                           0.894
##
## Model test baseline model:
##
##   Minimum Function Test Statistic              482.254
##   Degrees of freedom                                15
##   P-value                                        0.000
##
## User model versus baseline model:
##
##   Comparative Fit Index (CFI)                    1.000
##   Tucker-Lewis Index (TLI)                       1.021
##
## Loglikelihood and Information Criteria:
```

```
##
##   Loglikelihood user model (H0)                -641.787
##   Loglikelihood unrestricted model (H1)        -640.956
##
##   Number of free parameters                          22
##   Akaike (AIC)                                1327.574
##   Bayesian (BIC)                              1386.170
##   Sample-size adjusted Bayesian (BIC)         1316.664
##
## Root Mean Square Error of Approximation:
##
##   RMSEA                                          0.000
##   90 Percent Confidence Interval          0.000  0.060
##   P-value RMSEA <= 0.05                          0.936
##
## Standardized Root Mean Square Residual:
##
##   SRMR                                           0.015
##
## Parameter Estimates:
##
##   Information                                 Observed
##   Observed information based on                Hessian
##   Standard Errors                             Standard
##
## Latent Variables:
##                   Estimate  Std.Err  z-value  P(>|z|)
##   FC =~
##     MF      (lmMF)    0.573    0.117    4.903    0.000
##     MO      (lmMO)    1.068    0.086   12.349    0.000
##     MY      (lmMY)    1.278    0.099   12.907    0.000
##     FO      (lmFO)    1.163    0.075   15.578    0.000
##     FY      (lmFY)    1.166    0.083   14.092    0.000
##     YO      (lmYO)    0.753    0.106    7.100    0.000
##   I.M =~
##     MF                1.000
##     MO                1.000
##     MY                1.000
##   I.F =~
##     MF                1.000
##     FO                1.000
##     FY                1.000
##   I.O =~
##     MO                1.000
##     FO                1.000
##     YO                1.000
##   I.Y =~
##     MY                1.000
##     FY                1.000
##     YO                1.000
##   D.MF =~
##     MF                1.000
##   D.MO =~
##     MO                1.000
```

```
##   D.MY =~
##     MY                1.000
##   D.FO =~
##     FO                1.000
##   D.FY =~
##     FY                1.000
##   D.OY =~
##     YO                1.000
##
## Intercepts:
##                    Estimate  Std.Err  z-value  P(>|z|)
##     FC      (m.FC)    5.716    0.080   71.844    0.000
##     I.M    (m.I.M)    0.338    0.408    0.827    0.408
##     I.F    (m.I.F)    0.087    0.518    0.168    0.867
##     I.O    (m.I.O)    0.048    0.366    0.130    0.897
##     I.Y    (m.I.Y)   -0.472    0.328   -1.438    0.150
##     D.MF  (m.D.MF)    2.049    0.339    6.054    0.000
##     D.MO  (m.D.MO)   -0.727    0.232   -3.133    0.002
##     D.MY  (m.D.MY)   -1.322    0.240   -5.516    0.000
##     D.FO  (m.D.FO)   -1.322    0.240   -5.516    0.000
##     D.FY  (m.D.FY)   -0.727    0.232   -3.133    0.002
##     D.OY   (m.D.O)    2.049    0.339    6.054    0.000
##    .MF                0.000
##    .MO                0.000
##    .MY                0.000
##    .FO                0.000
##    .FY                0.000
##    .YO                0.000
##
## Variances:
##                    Estimate  Std.Err  z-value  P(>|z|)
##     FC     (VAR.F)    0.473    0.092    5.171    0.000
##     I.M  (VAR.I.M)    0.129    0.041    3.176    0.001
##     I.F  (VAR.I.F)    0.417    0.072    5.761    0.000
##     I.O  (VAR.I.O)    0.099    0.026    3.766    0.000
##     I.Y  (VAR.I.Y)    0.000       NA
##     D.M (VAR.D.MF)    0.261    0.079    3.288    0.001
##     D.M (VAR.D.MO)    0.168    0.044    3.850    0.000
##     D.M (VAR.D.MY)    0.063    0.052    1.210    0.226
##     D.F (VAR.D.FO)    0.045    0.032    1.429    0.153
##     D.F (VAR.D.FY)    0.094    0.032    2.942    0.003
##     D.O  (VAR.D.O)    0.473    0.074    6.385    0.000
##    .MF                0.000
##    .MO                0.000
##    .MY                0.000
##    .FO                0.000
##    .FY                0.000
##    .YO                0.000
##
## Defined Parameters:
##                    Estimate  Std.Err  z-value  P(>|z|)
##     diff              0.251    0.757    0.331    0.741
##
## Constraints:
```

```
##                                                |Slack|
##     mean.I.M+mean.I.F+mean.I.O+mean.I.Y - 0      0.000
##     mean.D.MF+mean.D.MO+mean.D.MY - 0            0.000
##     mean.D.MF+mean.D.FO+mean.D.FY - 0            0.000
##     mean.D.MY+mean.D.FY+mean.D.OY - 0            0.000
##     mean.D.MO+mean.D.FO+mean.D.OY - 0            0.000
##     lmbdMF+lmbdMO+lmbdMY+lmbdFO+lmbdFY+YO-(6)    0.000
##     VAR.FC - 0                                   0.473
##     VAR.I.M - 0                                  0.129
##     VAR.I.F - 0                                  0.417
##     VAR.I.O - 0                                  0.099
##     VAR.I.Y - 0                                  0.000
##     VAR.D.MF - 0                                 0.261
##     VAR.D.MO - 0                                 0.168
##     VAR.D.MY - 0                                 0.063
##     VAR.D.FO - 0                                 0.045
##     VAR.D.FY - 0                                 0.094
##     VAR.D.OY - 0                                 0.473
```

No significant difference between the amount of meals mothers and father share with all family members is found (diff = 0.251, p = 0.741).

Do mothers and fathers differ in the unique coordination they have with their children?

```
PDSRM4 <- paste0(PDSRM, 'diffO := mean.D.MO - mean.D.FO
                 diffY := mean.D.MY - mean.D.FY' )
fit4 <- lavaan(model = PDSRM4, data = mydata, missing = "fiml")
summary(fit4, fit.measures = T)
```

```
## lavaan 0.6-3 ended normally after 458 iterations
##
##   Optimization method                           NLMINB
##   Number of free parameters                         28
##   Number of inequality constraints                  11
##
##   Number of observations                           106
##   Number of missing patterns                         5
##
##   Estimator                                         ML
##   Model Fit Test Statistic                       1.663
##   Degrees of freedom                                 5
##   P-value (Chi-square)                           0.894
##
## Model test baseline model:
##
##   Minimum Function Test Statistic              482.254
##   Degrees of freedom                                15
##   P-value                                        0.000
##
## User model versus baseline model:
##
##   Comparative Fit Index (CFI)                    1.000
##   Tucker-Lewis Index (TLI)                       1.021
##
## Loglikelihood and Information Criteria:
##
```

```
##   Loglikelihood user model (H0)                -641.787
##   Loglikelihood unrestricted model (H1)        -640.956
##
##   Number of free parameters                          22
##   Akaike (AIC)                                1327.574
##   Bayesian (BIC)                              1386.170
##   Sample-size adjusted Bayesian (BIC)         1316.664
##
## Root Mean Square Error of Approximation:
##
##   RMSEA                                          0.000
##   90 Percent Confidence Interval          0.000  0.060
##   P-value RMSEA <= 0.05                          0.936
##
## Standardized Root Mean Square Residual:
##
##   SRMR                                           0.015
##
## Parameter Estimates:
##
##   Information                                 Observed
##   Observed information based on                Hessian
##   Standard Errors                             Standard
##
## Latent Variables:
##                    Estimate  Std.Err  z-value  P(>|z|)
##   FC =~
##     MF      (lmMF)    0.573    0.117    4.903    0.000
##     MO      (lmMO)    1.068    0.086   12.349    0.000
##     MY      (lmMY)    1.278    0.099   12.907    0.000
##     FO      (lmFO)    1.163    0.075   15.578    0.000
##     FY      (lmFY)    1.166    0.083   14.092    0.000
##     YO      (lmYO)    0.753    0.106    7.100    0.000
##   I.M =~
##     MF                1.000
##     MO                1.000
##     MY                1.000
##   I.F =~
##     MF                1.000
##     FO                1.000
##     FY                1.000
##   I.O =~
##     MO                1.000
##     FO                1.000
##     YO                1.000
##   I.Y =~
##     MY                1.000
##     FY                1.000
##     YO                1.000
##   D.MF =~
##     MF                1.000
##   D.MO =~
##     MO                1.000
##   D.MY =~
```

```
##     MY                1.000
##   D.FO =~
##     FO                1.000
##   D.FY =~
##     FY                1.000
##   D.OY =~
##     YO                1.000
##
## Intercepts:
##                    Estimate  Std.Err  z-value  P(>|z|)
##     FC      (m.FC)    5.716    0.080   71.844    0.000
##     I.M    (m.I.M)    0.338    0.408    0.827    0.408
##     I.F    (m.I.F)    0.087    0.518    0.168    0.867
##     I.O    (m.I.O)    0.048    0.366    0.130    0.897
##     I.Y    (m.I.Y)   -0.472    0.328   -1.438    0.150
##     D.MF  (m.D.MF)    2.049    0.339    6.054    0.000
##     D.MO  (m.D.MO)   -0.727    0.232   -3.133    0.002
##     D.MY  (m.D.MY)   -1.322    0.240   -5.516    0.000
##     D.FO  (m.D.FO)   -1.322    0.240   -5.516    0.000
##     D.FY  (m.D.FY)   -0.727    0.232   -3.133    0.002
##     D.OY   (m.D.O)    2.049    0.339    6.054    0.000
##    .MF                0.000
##    .MO                0.000
##    .MY                0.000
##    .FO                0.000
##    .FY                0.000
##    .YO                0.000
##
## Variances:
##                    Estimate  Std.Err  z-value  P(>|z|)
##     FC     (VAR.F)    0.473    0.092    5.171    0.000
##     I.M  (VAR.I.M)    0.129    0.041    3.176    0.001
##     I.F  (VAR.I.F)    0.417    0.072    5.761    0.000
##     I.O  (VAR.I.O)    0.099    0.026    3.766    0.000
##     I.Y  (VAR.I.Y)    0.000       NA
##     D.M (VAR.D.MF)    0.261    0.079    3.288    0.001
##     D.M (VAR.D.MO)    0.168    0.044    3.850    0.000
##     D.M (VAR.D.MY)    0.063    0.052    1.210    0.226
##     D.F (VAR.D.FO)    0.045    0.032    1.429    0.153
##     D.F (VAR.D.FY)    0.094    0.032    2.942    0.003
##     D.O  (VAR.D.O)    0.473    0.074    6.385    0.000
##    .MF                0.000
##    .MO                0.000
##    .MY                0.000
##    .FO                0.000
##    .FY                0.000
##    .YO                0.000
##
## Defined Parameters:
##                    Estimate  Std.Err  z-value  P(>|z|)
##     diffO             0.595    0.329    1.812    0.070
##     diffY            -0.595    0.329   -1.812    0.070
##
## Constraints:
```

```
##                                                |Slack|
##     mean.I.M+mean.I.F+mean.I.O+mean.I.Y - 0      0.000
##     mean.D.MF+mean.D.MO+mean.D.MY - 0            0.000
##     mean.D.MF+mean.D.FO+mean.D.FY - 0            0.000
##     mean.D.MY+mean.D.FY+mean.D.OY - 0            0.000
##     mean.D.MO+mean.D.FO+mean.D.OY - 0            0.000
##     lmbdMF+lmbdMO+lmbdMY+lmbdFO+lmbdFY+YO-(6)    0.000
##     VAR.FC - 0                                   0.473
##     VAR.I.M - 0                                  0.129
##     VAR.I.F - 0                                  0.417
##     VAR.I.O - 0                                  0.099
##     VAR.I.Y - 0                                  0.000
##     VAR.D.MF - 0                                 0.261
##     VAR.D.MO - 0                                 0.168
##     VAR.D.MY - 0                                 0.063
##     VAR.D.FO - 0                                 0.045
##     VAR.D.FY - 0                                 0.094
##     VAR.D.OY - 0                                 0.473
```

Second, a researcher might be interested in testing additional correlations between two PD SRM components. This can be done by placing a double tilde (i.e., ~~) between the two components of interest. For example, if one aims to investigate if it is true that the more meals the youngest child shares with the mother, the more these children also tend to share with the father, one can allow a correlation between the mother-youngest child dyadic component and the father-youngest child dyadic component (e.g., D.MY ~~D.FY).

```
PDSRM2 <- paste0(PDSRM, 'D.MY ~~ D.FY' )
fit2 <- lavaan(model = PDSRM2, data = mydata, missing = "fiml")
summary(fit2, fit.measures = T)
```

```
## lavaan 0.6-3 ended normally after 431 iterations
##
##   Optimization method                           NLMINB
##   Number of free parameters                         29
##   Number of inequality constraints                  11
##
##   Number of observations                           106
##   Number of missing patterns                         5
##
##   Estimator                                         ML
##   Model Fit Test Statistic                       1.644
##   Degrees of freedom                                 4
##   P-value (Chi-square)                           0.801
##
## Model test baseline model:
##
##   Minimum Function Test Statistic              482.254
##   Degrees of freedom                                15
##   P-value                                        0.000
##
## User model versus baseline model:
##
##   Comparative Fit Index (CFI)                    1.000
##   Tucker-Lewis Index (TLI)                       1.019
##
## Loglikelihood and Information Criteria:
```

```
##
##   Loglikelihood user model (H0)               -641.778
##   Loglikelihood unrestricted model (H1)       -640.956
##
##   Number of free parameters                         23
##   Akaike (AIC)                                1329.555
##   Bayesian (BIC)                              1390.814
##   Sample-size adjusted Bayesian (BIC)         1318.149
##
## Root Mean Square Error of Approximation:
##
##   RMSEA                                          0.000
##   90 Percent Confidence Interval          0.000  0.093
##   P-value RMSEA <= 0.05                          0.866
##
## Standardized Root Mean Square Residual:
##
##   SRMR                                           0.015
##
## Parameter Estimates:
##
##   Information                                 Observed
##   Observed information based on                Hessian
##   Standard Errors                             Standard
##
## Latent Variables:
##                   Estimate  Std.Err  z-value  P(>|z|)
##   FC =~
##     MF      (lmMF)    0.571    0.118    4.846    0.000
##     MO      (lmMO)    1.061    0.099   10.717    0.000
##     MY      (lmMY)    1.293    0.147    8.787    0.000
##     FO      (lmFO)    1.154    0.100   11.571    0.000
##     FY      (lmFY)    1.175    0.106   11.043    0.000
##     YO      (lmYO)    0.747    0.113    6.586    0.000
##   I.M =~
##     MF                1.000
##     MO                1.000
##     MY                1.000
##   I.F =~
##     MF                1.000
##     FO                1.000
##     FY                1.000
##   I.O =~
##     MO                1.000
##     FO                1.000
##     YO                1.000
##   I.Y =~
##     MY                1.000
##     FY                1.000
##     YO                1.000
##   D.MF =~
##     MF                1.000
##   D.MO =~
##     MO                1.000
```

```
##   D.MY =~
##     MY                1.000
##   D.FO =~
##     FO                1.000
##   D.FY =~
##     FY                1.000
##   D.OY =~
##     YO                1.000
##
## Covariances:
##                    Estimate  Std.Err  z-value  P(>|z|)
##   D.MY ~~
##     D.FY             -0.010    0.076   -0.135    0.892
##
## Intercepts:
##                    Estimate  Std.Err  z-value  P(>|z|)
##     FC      (m.FC)    5.716    0.079   71.899    0.000
##     I.M    (m.I.M)    0.321    0.426    0.753    0.451
##     I.F    (m.I.F)    0.092    0.520    0.177    0.859
##     I.O    (m.I.O)    0.109    0.579    0.189    0.850
##     I.Y    (m.I.Y)   -0.522    0.502   -1.041    0.298
##     D.MF  (m.D.MF)    2.071    0.377    5.498    0.000
##     D.MO  (m.D.MO)   -0.734    0.237   -3.089    0.002
##     D.MY  (m.D.MY)   -1.338    0.268   -4.993    0.000
##     D.FO  (m.D.FO)   -1.338    0.268   -4.993    0.000
##     D.FY  (m.D.FY)   -0.734    0.237   -3.089    0.002
##     D.OY   (m.D.O)    2.071    0.377    5.498    0.000
##    .MF                0.000
##    .MO                0.000
##    .MY                0.000
##    .FO                0.000
##    .FY                0.000
##    .YO                0.000
##
## Variances:
##                    Estimate  Std.Err  z-value  P(>|z|)
##     FC     (VAR.F)    0.471    0.092    5.096    0.000
##     I.M  (VAR.I.M)    0.128    0.041    3.132    0.002
##     I.F  (VAR.I.F)    0.419    0.073    5.704    0.000
##     I.O  (VAR.I.O)    0.107    0.061    1.752    0.080
##     I.Y  (VAR.I.Y)    0.000       NA
##     D.M (VAR.D.MF)    0.262    0.080    3.277    0.001
##     D.M (VAR.D.MO)    0.168    0.044    3.844    0.000
##     D.M (VAR.D.MY)    0.050    0.110    0.453    0.650
##     D.F (VAR.D.FO)    0.045    0.032    1.426    0.154
##     D.F (VAR.D.FY)    0.086    0.065    1.322    0.186
##     D.O  (VAR.D.O)    0.473    0.074    6.363    0.000
##    .MF                0.000
##    .MO                0.000
##    .MY                0.000
##    .FO                0.000
##    .FY                0.000
##    .YO                0.000
##
```

```
## Constraints:
##                                                 |Slack|
##     mean.I.M+mean.I.F+mean.I.O+mean.I.Y - 0       0.000
##     mean.D.MF+mean.D.MO+mean.D.MY - 0             0.000
##     mean.D.MF+mean.D.FO+mean.D.FY - 0             0.000
##     mean.D.MY+mean.D.FY+mean.D.OY - 0             0.000
##     mean.D.MO+mean.D.FO+mean.D.OY - 0             0.000
##     lmbdMF+lmbdMO+lmbdMY+lmbdFO+lmbdFY+YO-(6)     0.000
##     VAR.FC - 0                                    0.471
##     VAR.I.M - 0                                   0.128
##     VAR.I.F - 0                                   0.419
##     VAR.I.O - 0                                   0.107
##     VAR.I.Y - 0                                   0.000
##     VAR.D.MF - 0                                  0.262
##     VAR.D.MO - 0                                  0.168
##     VAR.D.MY - 0                                  0.050
##     VAR.D.FO - 0                                  0.045
##     VAR.D.FY - 0                                  0.086
##     VAR.D.OY - 0                                  0.473
```

As can be seen in the output, this correlation is not significant.

The PD SRM with two indicators

Now suppose you have a data set called `mydata2ind.txt`.

```
# read in your data
     mydata2ind <- read.table("mydata2ind.txt")
```

```
# The PD SRM with 2 indicators
PDSRM_2ind <- '
     # Latent variables
     FC =~ lambdaMF1*MF1 + lambdaMO1*MO1 + lambdaMY1*MY1 + lambdaFO1*FO1 + lambdaFY1*FY1 +
           lambdaYO1*YO1 + lambdaMF2*MF2 + lambdaMO2*MO2 + lambdaMY2*MY2 + lambdaFO2*FO2 +
           lambdaFY2*FY2 + lambdaYO2*YO2
     I.M =~  1*MF1 + 1*MO1 + 1*MY1 +
             1*MF2 + 1*MO2 + 1*MY2
     I.F =~  1*MF1 + 1*FO1 + 1*FY1 +
             1*MF2 + 1*FO2 + 1*FY2
     I.O =~  1*MO1  + 1*FO1 + 1*YO1 +
             1*MO2  + 1*FO2 + 1*YO2
     I.Y =~  1*MY1  + 1*FY1 + 1*YO1 +
             1*MY2  + 1*FY2 + 1*YO2
     D.MF =~ 1*MF1 + 1*MF2
     D.MO =~ 1*MO1 + 1*MO2
     D.MY =~ 1*MY1 + 1*MY2
     D.FO =~ 1*FO1 + 1*FO2
     D.FY =~ 1*FY1 + 1*FY2
     D.OY =~ 1*YO1 + 1*YO2

     # Variances
     FC ~~ VAR.FC*FC
     I.M ~~ VAR.I.M*I.M
     I.F ~~ VAR.I.F*I.F
```

```
I.O ~~ VAR.I.O*I.O
I.Y ~~ VAR.I.Y*I.Y
D.MF ~~ VAR.D.MF*D.MF
D.MO ~~ VAR.D.MO*D.MO
D.MY ~~ VAR.D.MY*D.MY
D.FO ~~ VAR.D.FO*D.FO
D.FY ~~ VAR.D.FY*D.FY
D.OY ~~ VAR.D.OY*D.OY
MF1 ~~ MF1
MO1 ~~ MO1
MY1 ~~ MY1
FO1 ~~ FO1
FY1 ~~ FY1
YO1 ~~ YO1
MF2 ~~ MF2
MO2 ~~ MO2
MY2 ~~ MY2
FO2 ~~ FO2
FY2 ~~ FY2
YO2 ~~ YO2

# Intercepts
FC ~ mean.FC*1
I.M ~ mean.I.M*1
I.F ~ mean.I.F*1
I.O ~ mean.I.O*1
I.Y ~ mean.I.Y*1
D.MF ~ mean.D.MF*1
D.MO ~ mean.D.MO*1
D.MY ~ mean.D.MY*1
D.FO ~ mean.D.FO*1
D.FY ~ mean.D.FY*1
D.OY ~ mean.D.OY*1

# intragenerational similarity
# I.M ~~ I.F
# I.O ~~ I.Y

# Constraints
mean.I.M + mean.I.F +  mean.I.O + mean.I.Y == 0
mean.D.MF + mean.D.MO + mean.D.MY == 0
mean.D.MF + mean.D.FO +  mean.D.FY == 0
mean.D.MY + mean.D.FY + mean.D.OY == 0
mean.D.MO + mean.D.FO + mean.D.OY == 0

# no negative variances are allowed (cfr. other software)
VAR.FC  > 0
VAR.I.M > 0
VAR.I.F > 0
VAR.I.O > 0
VAR.I.Y > 0
VAR.D.MF > 0
VAR.D.MO > 0
```

```
      VAR.D.MY > 0
      VAR.D.FO > 0
      VAR.D.FY > 0
      VAR.D.OY > 0

      # set constraints on factor loadings FE for identifiability
      12 == lambdaMF1 + lambdaMO1 + lambdaMY1 + lambdaFO1 + lambdaFY1 + lambdaYO1 +
            lambdaMF2 + lambdaMO2 + lambdaMY2 + lambdaFO2 + lambdaFY2 + lambdaYO2
      '

    # fit the model with your data and request a summary
    fit_2ind <- lavaan(data = mydata2ind, model = PDSRM_2ind)
    summary(fit_2ind, fit.measures = T)
```

```
## lavaan 0.6-3 ended normally after 170 iterations
##
##   Optimization method                           NLMINB
##   Number of free parameters                         46
##   Number of inequality constraints                  11
##
##   Number of observations                           500
##
##   Estimator                                         ML
##   Model Fit Test Statistic                      66.175
##   Degrees of freedom                                50
##   P-value (Chi-square)                           0.062
##
## Model test baseline model:
##
##   Minimum Function Test Statistic             5135.323
##   Degrees of freedom                                66
##   P-value                                        0.000
##
## User model versus baseline model:
##
##   Comparative Fit Index (CFI)                    0.997
##   Tucker-Lewis Index (TLI)                       0.996
##
## Loglikelihood and Information Criteria:
##
##   Loglikelihood user model (H0)             -11239.545
##   Loglikelihood unrestricted model (H1)     -11206.458
##
##   Number of free parameters                         40
##   Akaike (AIC)                               22559.091
##   Bayesian (BIC)                             22727.675
##   Sample-size adjusted Bayesian (BIC)        22600.713
##
## Root Mean Square Error of Approximation:
##
##   RMSEA                                          0.025
##   90 Percent Confidence Interval          0.000  0.041
##   P-value RMSEA <= 0.05                          0.998
##
```

```
## Standardized Root Mean Square Residual:
##
##   SRMR                                           0.017
##
## Parameter Estimates:
##
##   Information                                 Expected
##   Information saturated (h1) model          Structured
##   Standard Errors                             Standard
##
## Latent Variables:
##                    Estimate  Std.Err  z-value  P(>|z|)
##   FC =~
##     MF1     (lMF1)    0.921    0.068   13.648    0.000
##     MO1     (lMO1)    0.992    0.067   14.770    0.000
##     MY1     (lMY1)    1.138    0.071   16.003    0.000
##     FO1     (lFO1)    1.118    0.069   16.310    0.000
##     FY1     (lFY1)    1.221    0.067   18.174    0.000
##     YO1     (lYO1)    0.609    0.069    8.890    0.000
##     MF2     (lMF2)    0.936    0.067   13.900    0.000
##     MO2     (lMO2)    0.973    0.067   14.508    0.000
##     MY2     (lMY2)    1.146    0.071   16.132    0.000
##     FO2     (lFO2)    1.137    0.068   16.613    0.000
##     FY2     (lFY2)    1.210    0.067   18.056    0.000
##     YO2     (lYO2)    0.599    0.068    8.746    0.000
##   I.M =~
##     MF1               1.000
##     MO1               1.000
##     MY1               1.000
##     MF2               1.000
##     MO2               1.000
##     MY2               1.000
##   I.F =~
##     MF1               1.000
##     FO1               1.000
##     FY1               1.000
##     MF2               1.000
##     FO2               1.000
##     FY2               1.000
##   I.O =~
##     MO1               1.000
##     FO1               1.000
##     YO1               1.000
##     MO2               1.000
##     FO2               1.000
##     YO2               1.000
##   I.Y =~
##     MY1               1.000
##     FY1               1.000
##     YO1               1.000
##     MY2               1.000
##     FY2               1.000
##     YO2               1.000
##   D.MF =~
```

```
##     MF1                1.000
##     MF2                1.000
##   D.MO =~
##     MO1                1.000
##     MO2                1.000
##   D.MY =~
##     MY1                1.000
##     MY2                1.000
##   D.FO =~
##     FO1                1.000
##     FO2                1.000
##   D.FY =~
##     FY1                1.000
##     FY2                1.000
##   D.OY =~
##     YO1                1.000
##     YO2                1.000
##
## Intercepts:
##                    Estimate  Std.Err  z-value  P(>|z|)
##     FC      (m.FC)    3.957    0.081   49.137    0.000
##     I.M    (m.I.M)   -0.717    0.217   -3.308    0.001
##     I.F    (m.I.F)   -0.685    0.240   -2.859    0.004
##     I.O    (m.I.O)    0.540    0.201    2.688    0.007
##     I.Y    (m.I.Y)    0.863    0.214    4.025    0.000
##     D.MF  (m.D.MF)    1.130    0.114    9.902    0.000
##     D.MO  (m.D.MO)   -0.683    0.108   -6.312    0.000
##     D.MY  (m.D.MY)   -0.447    0.115   -3.902    0.000
##     D.FO  (m.D.FO)   -0.447    0.115   -3.902    0.000
##     D.FY  (m.D.FY)   -0.683    0.108   -6.312    0.000
##     D.OY   (m.D.O)    1.130    0.114    9.902    0.000
##    .MF1                0.000
##    .MO1                0.000
##    .MY1                0.000
##    .FO1                0.000
##    .FY1                0.000
##    .YO1                0.000
##    .MF2                0.000
##    .MO2                0.000
##    .MY2                0.000
##    .FO2                0.000
##    .FY2                0.000
##    .YO2                0.000
##
## Variances:
##                    Estimate  Std.Err  z-value  P(>|z|)
##     FC     (VAR.F)    1.950    0.215    9.068    0.000
##     I.M  (VAR.I.M)    1.084    0.137    7.897    0.000
##     I.F  (VAR.I.F)    1.269    0.174    7.275    0.000
##     I.O  (VAR.I.O)    1.083    0.117    9.221    0.000
##     I.Y  (VAR.I.Y)    1.032    0.131    7.876    0.000
##     D.M (VAR.D.MF)    0.574    0.147    3.906    0.000
##     D.M (VAR.D.MO)    0.574    0.153    3.761    0.000
##     D.M (VAR.D.MY)    0.662    0.171    3.862    0.000
```

```
##     D.F (VAR.D.FO)    0.686    0.165    4.167    0.000
##     D.F (VAR.D.FY)    0.273    0.149    1.837    0.066
##     D.O  (VAR.D.O)    0.526    0.149    3.522    0.000
##    .MF1               1.157    0.118    9.767    0.000
##    .MO1               1.086    0.117    9.272    0.000
##    .MY1               1.075    0.119    9.016    0.000
##    .FO1               1.094    0.118    9.300    0.000
##    .FY1               1.058    0.109    9.716    0.000
##    .YO1               1.048    0.112    9.318    0.000
##    .MF2               0.921    0.110    8.391    0.000
##    .MO2               0.969    0.112    8.618    0.000
##    .MY2               0.977    0.116    8.422    0.000
##    .FO2               0.871    0.110    7.891    0.000
##    .FY2               0.803    0.099    8.073    0.000
##    .YO2               0.974    0.110    8.861    0.000
##
## Constraints:
##                                                  |Slack|
##     mean.I.M+mean.I.F+mean.I.O+mean.I.Y - 0         0.000
##     mean.D.MF+mean.D.MO+mean.D.MY - 0               0.000
##     mean.D.MF+mean.D.FO+mean.D.FY - 0               0.000
##     mean.D.MY+mean.D.FY+mean.D.OY - 0               0.000
##     mean.D.MO+mean.D.FO+mean.D.OY - 0               0.000
##     VAR.FC - 0                                      1.950
##     VAR.I.M - 0                                     1.084
##     VAR.I.F - 0                                     1.269
##     VAR.I.O - 0                                     1.083
##     VAR.I.Y - 0                                     1.032
##     VAR.D.MF - 0                                    0.574
##     VAR.D.MO - 0                                    0.574
##     VAR.D.MY - 0                                    0.662
##     VAR.D.FO - 0                                    0.686
##     VAR.D.FY - 0                                    0.273
##     VAR.D.OY - 0                                    0.526
##     12-(MF1+MO1+MY1+FO1+FY1+YO1+MF2+MO2+MY2+F       0.000
```