

Package ‘srm’

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Title Structural Equation Modeling for the Social Relations Model

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Description Provides functionality for structural equation modeling for the social relations model (Kenny & La Voie, 1984; <doi:10.1016/S0065-2601(08)60144-6>; Warner, Kenny, & Soto, 1979, <doi:10.1037/0022-3514.37.10.1742>). Maximum likelihood estimation (Gill & Swartz, 2001, <doi:10.2307/3316080>; Nestler, 2018, <doi:10.3102/1076998617741106>) and least squares estimation is supported (Bond & Malloy, 2018, <doi:10.1016/B978-0-12-811967-9.00014-X>).

Depends R (>= 3.1)

Imports Rcpp, stats, utils

Enhances amen, TripleR

LinkingTo Rcpp, RcppArmadillo

License GPL (>= 2)

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<https://sites.google.com/site/alexanderrobitzsch2/software>

NeedsCompilation yes

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srm-package	<i>Structural Equation Modeling for the Social Relations Model</i>
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Description

Provides functionality for structural equation modeling for the social relations model (Kenny & La Voie, 1984; <doi:10.1016/S0065-2601(08)60144-6>; Warner, Kenny, & Soto, 1979, <doi:10.1037/0022-3514.37.10.1742>). Maximum likelihood estimation (Gill & Swartz, 2001, <doi:10.2307/3316080>; Nestler, 2018, <doi:10.3102/1076998617741106>) and least squares estimation is supported (Bond & Malloy, 2018, <doi:10.1016/B978-0-12-811967-9.00014-X>).

Author(s)

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References

- Bond, C. F., & Malloy, T. E. (2018a). Social relations analysis of dyadic data structure: The general case. In T. E. Malloy. *Social relations modeling of behavior in dyads and groups* (Ch. 14). Academic Press. doi: [10.1016/B9780128119679.00014X](https://doi.org/10.1016/B9780128119679.00014X)
- Gill, P. S., & Swartz, T. B. (2001). Statistical analyses for round robin interaction data. *Canadian Journal of Statistics*, 29(2), 321-331. doi: [10.2307/3316080](https://doi.org/10.2307/3316080)
- Kenny, D. A., & La Voie, L. J. (1984). The social relations model. In L. Berkowitz (Ed.), *Advances in experimental social psychology* (Vol. 18, pp. 142-182). Orlando, FL: Academic. doi: [10.1016/S00652601\(08\)601446](https://doi.org/10.1016/S00652601(08)601446)
- Nestler, S. (2018). Likelihood estimation of the multivariate social relations model. *Journal of Educational and Behavioral Statistics*, 43(4), 387-406. doi: [10.3102/1076998617741106](https://doi.org/10.3102/1076998617741106)
- Warner, R. M., Kenny, D. A., & Soto, M. (1979). A new round robin analysis of variance for social interaction data. *Journal of Personality and Social Psychology*, 37(10), 1742-1757. doi: [10.1037/00223514.37.10.1742](https://doi.org/10.1037/00223514.37.10.1742)

See Also

See also the R packages **amen** and **TripleR** for estimating the social relations model.

data.back	<i>Dataset Back et al. (2011)</i>
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Description

Dataset used in Back, Schmukle and Egloff (2011).

Usage

```
data(data.back)
```

Format

- The dataset data.back is a round-robin design with 54 units and has the following structure
'data.frame': 2862 obs. of 8 variables:
\$ Group : num 1 1 1 1 1 1 1 1 1 1 ...
\$ Actor : int 1 1 1 1 1 1 1 1 1 1 ...
\$ Partner: int 2 3 4 5 6 7 8 9 10 11 ...
\$ Dyad : int 1 2 3 4 5 6 7 8 9 10 ...
\$ y : int 3 3 2 2 4 3 3 2 3 3 ...
\$ sex : int 1 1 1 1 1 1 1 1 1 1 ...
\$ age : int 22 22 22 22 22 22 22 22 22 22 ...
\$ n : num -1.17 -1.17 -1.17 -1.17 -1.17 -1.17 -1.17 -1.17 -1.17 -1.17 ...

Source

<https://osf.io/zd67x/>

References

Back, M. D., Schmukle, S. C., & Egloff, B. (2011). A closer look at first sight: Social relations lens model analysis of personality and interpersonal attraction at zero acquaintance. *European Journal of Personality*, 25(3), 225-238. doi: [10.1002/per.790](https://doi.org/10.1002/per.790)

data.bm	<i>Dataset Bond and Malloy (2018)</i>
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Description

This is the illustration dataset of Bond and Malloy (2018) for a bivariate social relations model. The round robin design contains 16 persons and some missing values for one person.

Usage

```
data(data.bm1)  
data(data.bm2)
```

Format

- The dataset `data.bm1` contains all ratings in a wide format. The two outcomes are arranged one below the other.

```
'data.frame': 32 obs. of 16 variables:
 $ a: int NA 12 13 14 15 15 14 14 13 13 ...
 $ b: int 10 NA 10 18 7 15 14 8 12 12 ...
 $ c: int 13 12 NA 14 13 14 13 13 11 12 ...
 [... ]
 $ p: int 11 13 14 14 9 8 17 13 11 12 ...
```

- The dataset `data.bm2` is a subdataset of `data.bm1` which contains observations 9 to 16.

Source

<http://thomasmalloy.org/arbsrm-the-general-social-relations-model/>

References

Bond, C. F., & Malloy, T. E. (2018a). Social relations analysis of dyadic data structure: The general case. In T. E. Malloy. *Social relations modeling of behavior in dyads and groups* (Ch. 14). Academic Press. doi: [10.1016/B9780128119679.00014X](https://doi.org/10.1016/B9780128119679.00014X)

data.srm

Example Datasets for the srm Package

Description

Some simulated example datasets for the **srm** package.

Usage

```
data(data.srm01)
```

Format

- The dataset `data.srm01` contains three variables, 10 round robin groups with 10 members each.

```
'data.frame': 900 obs. of 7 variables:
 $ Group : num 1 1 1 1 1 1 1 1 1 1 ...
 $ dyad : num 1 2 3 4 5 6 7 8 9 10 ...
 $ Actor : num 1 1 1 1 1 1 1 1 1 2 ...
 $ Partner: num 2 3 4 5 6 7 8 9 10 3 ...
 $ Wert1 : num -0.15 -0.95 0.82 1.15 -1.79 1.17 1.79 -0.57 -0.46 1.19 ...
 $ Wert2 : num -0.77 0.17 0.42 0.16 -0.44 0.89 1.67 -1.9 -0.74 2.67 ...
 $ Wert3 : num -0.49 0.08 -0.12 1.16 -2.78 -0.74 2.66 -1.28 -0.45 1.93 ...
```

HallmarkKenny

Hallmark and Kenny Round Robin Data

Description

Data from Kenny et al. (1994)

Usage

```
data(HallmarkKenny)
```

Format

A data frame with 802 measurements of 30 round-robin groups on the following 7 round-robin variables (taken on unnumbered 7-point rating scales with higher numbers indicating a higher value of the trait):

calm: rating of dimension calm-anxious
sociable rating of dimension sociable-withdrawn
liking rating of dimension like-do not like
careful rating of dimension careful-careless
relaxed rating of dimension relaxed-tense
talkative rating of dimension talkative-quiet
responsible rating of dimension responsible-undependable

The data frame also contains participants gender (`actor . sex`; 1 = F, 2 = M) and their age in years (`actor . age`). Note that the data was assessed in two conditions: odd round robin group numbers indicate groups in which participants rated all traits for a person at a time whereas even numbers refer to groups in which participants rated all the people for each trait.

Source

<http://davidakenny.net/srm/srmdata.htm>

References

Kenny, D. A., Albright, L., Malloy, T. E., & Kashy, D. A. (1994). Consensus in interpersonal perception: Acquaintance and the big five. *Psychological Bulletin*, *116*(2), 245-258. doi: [10.1037/00332909.116.2.245](https://doi.org/10.1037/00332909.116.2.245)

Kenzer

Zero Acquaintance Round Robin Data from Kenny

Description

Data from Albright et al. (1988) Study 2

Usage

data(Kenzer)

Format

A data frame with 124 measurements from 7 round-robin groups on the following 5 round-robin variables (taken on unnumbered 7-point rating scales with higher numbers indicating a higher value of the trait):

sociable: rating of dimension sociable
irritable: rating of dimension good-natured
responsible: rating of dimension responsible
anxious: rating of dimension calm
intellectual: rating of dimension intellectual

The data frame also contains the gender (`actor.sex`; 1 = F, 2 = M) of the participants and their self-ratings on the five assessed traits (`actor.sociable` and so on).

Source

<http://davidakenny.net/srm/srmdata.htm>

References

Albright, L., Kenny, D. A., & Malloy, T. E. (1988). Consensus in personality judgments at zero acquaintance. *Journal of Personality and Social Psychology*, 55(3), 387-395. doi: [10.1037/0022-3514.55.3.387](https://doi.org/10.1037/0022-3514.55.3.387)

Malzer

Zero Acquaintance Round Robin Data from Malloy

Description

Data from Albright et al. (1988) Study 1

Usage

data(Malzer)

Format

A data frame with 216 measurements from 12 round-robin groups on the following 5 round-robin variables (assessed on numbered 7-point rating scales with higher numbers indicating a higher value of the trait with the exception for good and calm):

```
sociable: rating of dimension sociable
irritable: rating of dimension good-natured
responsible: rating of dimension responsible
anxious: rating of dimension calm
intellectual: rating of dimension intellectual
```

The data frame also contains the gender (`actor.sex`; 1 = F, 2 = M) of the participants and their self-ratings on the five assessed traits (`actor.sociable` and so on).

Source

<http://davidakenny.net/srm/srmdata.htm>

References

Albright, L., Kenny, D. A., & Malloy, T. E. (1988). Consensus in personality judgments at zero acquaintance. *Journal of Personality and Social Psychology*, *55*(3), 387-395. doi: [10.1037/0022-3514.55.3.387](https://doi.org/10.1037/0022-3514.55.3.387)

srm

Structural Equation Model for the Social Relations Model

Description

Provides an estimation routine for a multiple group structural equation model for the social relations model (SRM; Kenny & La Voie, 1984; Warner, Kenny, & Soto, 1979). The model is estimated by maximum likelihood (Gill & Swartz, 2001; Nestler, 2018).

Usage

```
srm(model.syntax = NULL, data = NULL, group.var = NULL, rrgroup_name = NULL,
     person_names = c("Actor", "Partner"), fixed.groups = FALSE, var_positive = -1,
     optimizer = "srm", maxiter = 300, conv_dev = 1e-08, conv_par = 1e-06,
     do_line_search = TRUE, line_search_iter_max = 6, verbose = TRUE, use_rcpp = TRUE,
     shortcut = TRUE, use_woodbury = TRUE)
```

```
## S3 method for class 'srm'
coef(object, ...)
## S3 method for class 'srm'
vcov(object, ...)
## S3 method for class 'srm'
```

```
summary(object, digits=3, file=NULL, layout=1, ...)
## S3 method for class 'srm'
logLik(object, ...)
```

Arguments

model.syntax	Syntax similar to lavaan language, see Examples.
data	Data frame containing round robin identifier variables and variables in the round robin design
group.var	Name of grouping variable
rrgroup_name	Name of variable indicating round robin group
person_names	Names for identifier variables for actors and partners
fixed.groups	Logical indicating whether groups should be handled with fixed effects
var_positive	Nonnegative value if variances are constrained to be positive
optimizer	Optimizer to be used: "srm" for internal optimization using Fisher scoring and "nlminb" for L-FBGS optimization.
maxiter	Maximum number of iterations
conv_dev	Convergence criterion for change relative deviance
conv_par	Convergence criterion for change in parameters
do_line_search	Logical indicating whether line search should be performed
line_search_iter_max	Number of iterations during line search algorithm
verbose	Logical indicating whether convergence progress should be displayed
use_rcpp	Logical indicating whether Rcpp package should be used
shortcut	Logical indicating whether shortcuts for round robin groups with same structure should be used
use_woodbury	Logical indicating whether matrix inversion should be simplified by Woodbury identity
object	Object of class srm
file	Optional file name for summary output
digits	Number of digits after decimal in summary output
layout	Different layouts (1 or 2) for layout of summary
...	Further arguments to be passed

Value

List with following entries (selection)

parm.table	Parameter table with estimated values
coef	Vector of parameter estimates
vcov	Covariance matrix of parameter estimates
parm_list	List of model matrices
sigma	Model implied covariance matrices
...	Further values

References

- Gill, P. S., & Swartz, T. B. (2001). Statistical analyses for round robin interaction data. *Canadian Journal of Statistics*, 29(2), 321-331. doi: [10.2307/3316080](https://doi.org/10.2307/3316080)
- Kenny, D. A., & La Voie, L. J. (1984). The social relations model. In L. Berkowitz (Ed.), *Advances in experimental social psychology* (Vol. 18, pp. 142-182). Orlando, FL: Academic. doi: [10.1016/S00652601\(08\)601446](https://doi.org/10.1016/S00652601(08)601446)
- Nestler, S. (2018). Likelihood estimation of the multivariate social relations model. *Journal of Educational and Behavioral Statistics*, 43(4), 387-406. doi: [10.3102/1076998617741106](https://doi.org/10.3102/1076998617741106)
- Warner, R. M., Kenny, D. A., & Soto, M. (1979). A new round robin analysis of variance for social interaction data. *Journal of Personality and Social Psychology*, 37(10), 1742-1757. doi: [10.1037/00223514.37.10.1742](https://doi.org/10.1037/00223514.37.10.1742)

See Also

See also **TripleR** and **amen** packages for alternative estimation routines for the SRM.

Examples

```
#####
# EXAMPLE 1: Univariate SRM
#####

data(data.srm01, package="srm")
dat <- data.srm01

#-- define model
mf <- '
%Person
F1@A =~ 1*Wert1@A
F1@P =~ 1*Wert1@P
Wert1@A ~~ 0*Wert1@A + 0*Wert1@P
Wert1@P ~~ 0*Wert1@P

%Dyad
F1@AP =~ 1*Wert1@AP
F1@PA =~ 1*Wert1@PA
Wert1@AP ~~ 0*Wert1@AP + 0*Wert1@PA
Wert1@PA ~~ 0*Wert1@PA
'

#-- estimate model
mod1 <- srm::srm(mf, data = dat, rrgroup_name="Group", conv_par=1e-4, maxiter=20)
summary(mod1)
round(coef(mod1),3)

#####
# EXAMPLE 2: Bivariate SRM
#####
```

```

data(data.srm01, package="srm")
dat <- data.srm01

#-- define model
mf <- '
%Person
F1@A =~ 1*Wert1@A
F1@P =~ 1*Wert1@P
F2@A =~ 1*Wert2@A
F2@P =~ 1*Wert2@P
Wert1@A ~~ 0*Wert1@A + 0*Wert1@P
Wert1@P ~~ 0*Wert1@P
Wert2@A ~~ 0*Wert2@A + 0*Wert2@P
Wert2@P ~~ 0*Wert2@P

%Dyad
F1@AP =~ 1*Wert1@AP
F1@PA =~ 1*Wert1@PA
F2@AP =~ 1*Wert2@AP
F2@PA =~ 1*Wert2@PA
Wert1@AP ~~ 0*Wert1@AP + 0*Wert1@PA
Wert1@PA ~~ 0*Wert1@PA
Wert2@AP ~~ 0*Wert2@AP + 0*Wert2@PA
Wert2@PA ~~ 0*Wert2@PA
'

#-- estimate model
mod1 <- srm::srm(mf, data = dat, rrgroup_name="Group", conv_par=1e-4, maxiter=20)
summary(mod1)

#####
# EXAMPLE 3: One-factor model
#####

data(data.srm01, package="srm")
dat <- data.srm01

#-- define model
mf <- '
# definition of factor for persons and dyad
%Person
f1@A=~Wert1@A+Wert2@A+Wert3@A
f1@P=~Wert1@P+Wert2@P+Wert3@P

%Dyad
f1@AP=~Wert1@AP+Wert2@AP+Wert3@AP

# define some constraints
Wert1@AP ~~ 0*Wert1@PA
Wert3@AP ~~ 0*Wert3@PA
'

#-- estimate model
mod1 <- srm::srm(mf, data = dat, rrgroup_name="Group", conv_par=1e-4)

```

```
summary(mod1)
coef(mod1)

#- use stats::nlminb() optimizer
mod1 <- srm::srm(mf, data = dat, rrgroup_name="Group", optimizer="nlminb", conv_par=1e-4)
summary(mod1)
```

srm_arbsrm	<i>Least Squares Estimation of the Social Relations Model (Bond & Malloy, 2018)</i>
------------	---

Description

Provides least squares estimation of the bivariate social relations model with missing completely at random data (Bond & Malloy, 2018a). The code is basically taken from Bond and Malloy (2018b) and rewritten for reasons of computation time reduction.

Usage

```
srm_arbsrm(data, error = TRUE, use_srm = TRUE)

## S3 method for class 'srm_arbsrm'
coef(object, ...)
## S3 method for class 'srm_arbsrm'
summary(object, digits=3, file=NULL, ...)
```

Arguments

data	Rectangular dataset currently containing only one round robin group. Bivariate observations are stacked one below the other (see example dataset <code>data.bm1</code>).
error	Logical indicating whether standard errors should be calculated.
use_srm	Logical indicating whether the rewritten code (TRUE) or the original code of Bond and Malloy (2018b) should be used.
object	Object of class <code>srm_arbsrm</code>
file	Optional file name for summary output
digits	Number of digits after decimal in summary output
...	Further arguments to be passed

Value

List containing entries

par_summary	Parameter summary table
est	Estimated parameters (as in Bond & Malloy, 2018b)
se	Estimated standard errors (as in Bond & Malloy, 2018b)

Note

If you use this function, please also cite Bond and Malloy (2018a).

Author(s)

Rewritten code of Bond and Malloy (2018b). See <http://thomasemalloy.org/arbsrm-the-general-social-relations> and <http://thomasemalloy.org/wp-content/uploads/2017/09/arbcodeR.pdf>.

References

Bond, C. F., & Malloy, T. E. (2018a). Social relations analysis of dyadic data structure: The general case. In T. E. Malloy. *Social relations modeling of behavior in dyads and groups* (Ch. 14). Academic Press. doi: [10.1016/B9780128119679.00014X](https://doi.org/10.1016/B9780128119679.00014X)

Bond, C. F., & Malloy, T. E. (2018b). *ARBSRM - The general social relations model*. <http://thomasemalloy.org/arbsrm-the-general-social-relations-model/>.

See Also

Without missing data, ANOVA estimation can be conducted with the **TripleR** package.

Examples

```
#####
# EXAMPLE 1: Bond and Malloy (2018) illustration dataset
#####

data(data.bm2, package="srm")
dat <- data.bm2

#- estimation
mod1 <- srm::srm_arbsrm(dat)
mod1$par_summary
coef(mod1)
summary(mod1)

#-- estimation with original Bond and Malloy code
mod1a <- srm::srm_arbsrm(dat, use_srm=FALSE)
summary(mod1a)
```

Description

Data from Warner et al. (1979)

Usage

data(Warner)

Format

A data frame with 56 measurements of a single round-robin group on a single round-robin variable that was measured at three consecutive time points. The variable reflects the proportion of time an actor spent when speaking to a partner.

prop.T1: proportion of time spent in the first interaction
prop.T2: proportion of time spent in the second interaction
prop.T3: proportion of time spent in the third interaction

Source

See Table 7 (p. 1752) of the Warner et al. (1979).

References

Warner, R. M., Kenny, D. A., & Soto, M. (1979). A new round robin analysis of variance for social interaction data. *Journal of Personality and Social Psychology*, 37(10), 1742-1757. doi: [10.1037/00223514.37.10.1742](https://doi.org/10.1037/00223514.37.10.1742)

Zero

Zero Acquaintance Round Robin Data From Albright, Kenny, and Malloy

Description

Data from Study 3 of Albright et al. (1988)

Usage

data(Zero)

Format

A data frame with 636 measurements of 36 round robin groups on the following 15 round-robin variables (taken on 7-point rating scales with higher values indicating more of the trait):

sociable: rating of dimension sociable-reclusive
good: rating of dimension good-natured-irritable
responsible: rating of dimension responsible-undependable
calm: rating of dimension calm-anxious
intellectual: rating of dimension intellectual-unintellectual
imaginative: rating of dimension imaginative-unimaginative

talkative: rating of dimension talkative-silent
fussy: rating of dimension fussy-careless
composed: rating of dimension composed-excitabile
cooperative: rating of dimension cooperative-negativistic
physically_attractive: rating of dimension physically attractive-unattractive
formal_dress: rating of dimension formal dress-casual dress
neatly_dressed: rating of dimension neatly dressed-sloppy dress
athletic: rating of dimension athletic-not athletic
young: rating of dimension young-old

The data frame also contains the gender (`actor.sex`; 1 = F, 2 = M) of the participants and their self-ratings on the five assessed traits (`actor.sociable` and so on).

Source

<http://davidakenny.net/srm/srmdata.htm>

References

Albright, L., Kenny, D. A., & Malloy, T. E. (1988). Consensus in personality judgments at zero acquaintance. *Journal of Personality and Social Psychology*, 55(3), 387-395. doi: [10.1037/0022-3514.55.3.387](https://doi.org/10.1037/0022-3514.55.3.387)

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