# Package 'mulSEM'

May 9, 2026

**Type** Package

**Title** Some Multivariate Analyses using Structural Equation Modeling

**Version** 1.2

**Date** 2026-02-16

**Depends** R (>= 4.3.0), OpenMx

**Imports** stats

**Encoding** UTF-8

**Description** A set of functions for some multivariate analyses utilizing a structural equation modeling (SEM) approach through the 'OpenMx' package. These analyses include canonical correlation analysis (CANCORR), redundancy analysis (RDA), and multivariate principal component regression (MPCR). It implements procedures discussed in Gu and Cheung (2023) <doi:10.1111/bmsp.12301>, Gu, Yung, and Cheung (2019) <doi:10.1080/00273171.2018.1512847>, and Gu et al. (2023) <doi:10.1080/00273171.2022.2141675>.

**License** GPL (>= 2)

**LazyLoad** yes

**LazyData** yes

**ByteCompile** yes

**URL** https://github.com/mikewlcheung/mulsem

**BugReports** https://github.com/mikewlcheung/mulsem/issues

**Suggests** roxygen2

**RoxygenNote** 7.3.3

**NeedsCompilation** no

**Author** Mike Cheung [aut, cre] (ORCID: <https://orcid.org/0000-0003-0113-0758>), Fei Gu [ctb] (ORCID: <https://orcid.org/0000-0002-1753-8398>), Yiu-Fai Yung [ctb]

**Maintainer** Mike Cheung <mikewlcheung@nus.edu.sg>

**Repository** CRAN

**Date/Publication** 2026-02-17 01:00:02 UTC

# Contents



---

`cancorr` *Canonical correlation analysis*

---

## Description

This function conducts canonical correlation analysis using the OpenMx package. Missing data are handled with the full information maximum likelihood method when raw data are available. It provides standard errors for the estimates.

## Usage

```
cancorr(
  X_vars,
  Y_vars,
  data = NULL,
  Cov = NULL,
  numObs = NULL,
  model = c("CORR-W", "CORR-L", "COV-W", "COV-L"),
  extraTries = 50,
  ...
)
```

## Arguments

| | |
|---|---|
| `X_vars` | A vector of characters of the X variables. |
| `Y_vars` | A vector of characters of the Y variables. |
| `data` | A data frame containing raw data. If NULL, `Cov` and `numObs` must be provided. |
| `Cov` | A covariance or correlation matrix. Required when `data` is NULL. |
| `numObs` | A sample size. Required when `data` is NULL. |

| | |
|---|---|
| model | Four models defined in Gu, Yung, and Cheung (2019). CORR and COV refer to analyses of correlation structures and covariance structures, respectively. |
| extraTries | This function calls OpenMx::mxTryHard() to obtain parameter estimates and their standard errors. extraTries is the number of extra runs. If extraTries=0, OpenMx::mxRun() is called. |
| ... | Additional arguments passed to either OpenMx::mxTryHard() or OpenMx::mxRun(). |

## Value

A list with class CanCorr. It stores the model in OpenMx objects. The fitted object is stored in mx.fit.

## Note

cancorr expects the number of variables in Y_vars to be equal to or greater than that in X_vars. If there are fewer in Y_vars, you may swap between X_vars and Y_vars.

## Author(s)

Mike W.-L. Cheung mikewlcheung@nus.edu.sg

## References

Gu, F., Yung, Y.-F., & Cheung, M. W.-L. (2019). Four covariance structure models for canonical correlation analysis: A COSAN modeling approach. *Multivariate Behavioral Research*, **54(2)**, 192-223. doi:10.1080/00273171.2018.1512847

## See Also

Thorndike00, sas_ex1

## Examples

```
## Canonical Correlation Analysis
cancorr(X_vars=c("Weight", "Waist", "Pulse"),
        Y_vars=c("Chins", "Situps", "Jumps"),
        data=sas_ex1)
```

---

# Chittum19 *Correlation matrix of a model of motivation*

---

## Description

This dataset includes a correlation matrix of 12 variables (n=533) of a model of motivation reported by Chittum, Jones, and Carter (2019).

## Usage

```
Chittum19
```

## Format

A list with the following components:

**data** A 12x12 correlation matrix.

**n** A sample size (533).

## Source

Chittum, J. R., Jones, B. D., & Carter, D. M. (2019). A person-centered investigation of patterns in college students' perceptions of motivation in a course. *Learning and Individual Differences*, **69**, 94-107. doi:10.1016/j.lindif.2018.11.007

## References

Gu, F., Yung, Y.-F., Cheung, M. W.-L., Joo, B.-K., & Nimon, K. (2023). Statistical inference in redundancy analysis: A direct covariance structure modeling approach. *Multivariate Behavioral Research*, **58(5)**, 877-893. doi:10.1080/00273171.2022.2141675

## Examples

```
data(Chittum19)

## Redundancy Analysis
rda(X_vars=c("Empowerment", "Usefulness", "Success", "Interest", "Caring"),
    Y_vars=c("Final_Exam", "Learning", "Course_Rating", "Instr_Rating",
             "Effort", "Cog_Engage", "Cost"),
    Cov=Chittum19$data, numObs=Chittum19$n)
```

---

# Lambert88 *Correlation matrix of artificial data*

---

## Description

This dataset includes a correlation matrix of nine artificial variables used in Table 1 of Lambert, Wildt, and Durand (1988).

## Usage

```
Lambert88
```

## Format

A 9x9 correlation matrix.

## Source

Lambert, Z. V., Wildt, A. R., & Durand, R. M. (1988). Redundancy analysis: An alternative to canonical correlation and multivariate multiple regression in exploring interset associations. *Psychological Bulletin*, **104(2)**, 282-289. doi:10.1037/00332909.104.2.282

## References

Gu, F., Yung, Y.-F., Cheung, M. W.-L., Joo, B.-K., & Nimon, K. (2023). Statistical inference in redundancy analysis: A direct covariance structure modeling approach. *Multivariate Behavioral Research*, **58(5)**, 877-893. doi:10.1080/00273171.2022.2141675

## Examples

```
data(Lambert88)


## Redundancy Analysis
rda(X_vars=paste0("x", 1:5), Y_vars=paste0("y", 1:4), Cov=Lambert88, numObs=100)
```

---

# mpcr *Multivariate Principal Component Regression (MPCR)*

---

## Description

Conduct multivariate principal component regression

## Usage

```
mpcr(
  X_vars,
  Y_vars,
  data = NULL,
  Cov = NULL,
  Means = NULL,
  numObs = NULL,
  pca = c("COV", "COR"),
  pc_select = NULL,
  extraTries = 50,
  ...
)
```

## Arguments

| | |
|---|---|
| X_vars | A vector of characters of the X variables. |
| Y_vars | A vector of characters of the Y variables. |
| data | A data frame containing raw data. If NULL, Cov and numObs must be provided. |

| | |
|---|---|
| Cov | A covariance or correlation matrix. Required when data is NULL. |
| Means | An optional mean vector. Can be provided when data is NULL. |
| numObs | A sample size. Required when data is NULL. |
| pca | Whether principal component analysis is based on unstandardized (COV) or standardized (COR) variables. |
| pc_select | PCs selected in the regression analysis. For example, pc_select=c(1,2) to use the first two PCs in the multiple regression analysis. |
| extraTries | This function calls OpenMx::mxTryHard() to obtain parameter estimates and their standard errors. extraTries is the number of extra runs. If extraTries=0, OpenMx::mxRun() is called. |
| ... | Additional arguments passed to either OpenMx::mxTryHard() or OpenMx::mxRun(). |

## Details

This function conducts multivariate principal component regression using the OpenMx package. Missing data are handled with the full information maximum likelihood method when raw data are available. It provides standard errors for the estimates.

## Value

A list with class MPCR. It stores the model in OpenMx objects. The fitted object is stored in mx.fit.

## Author(s)

Mike W.-L. Cheung mikewlcheung@nus.edu.sg

## References

Gu, F., & Cheung, M. W.-L. (2023). A model-based approach to multivariate principal component regression: Selection of principal components and standard error estimates for unstandardized regression coefficients. *British Journal of Mathematical and Statistical Psychology*, **76(3)**, 605-622. doi:10.1111/bmsp.12301

## See Also

Nimon21

## Examples

```
## Multivariate Principal Component Regression
mpcr(X_vars=c("AU", "CC", "CL", "CO", "DF", "FB", "GR", "MW"),
     Y_vars=c("IDE", "IEE", "IOCB", "IPR", "ITS"),
     pca="COR", pc_select=1,
     data=Nimon21)
```

Nimon21 *Raw data used in Nimon, Joo, and Bontrager (2021)*

## Description

This dataset includes the raw data of 13 variables reported by Nimon, Joo, and Bontrager (2021).

## Usage

```
Nimon21
```

## Format

A data frame with 13 variables.

## Source

Nimon, K., Joo, B.-K. (Brian), & Bontrager, M. (2021). Work cognitions and work intentions: A canonical correlation study. *Human Resource Development International*, **24(1)**, 65-91. doi:10.1080/13678868.2020.1775038

## References

Gu, F., & Cheung, M. W.-L. (2023). A Model-based approach to multivariate principal component regression: Selection of principal components and standard error estimates for unstandardized regression coefficients. *British Journal of Mathematical and Statistical Psychology*, **76(3)**, 605-622. doi:10.1111/bmsp.12301

Gu, F., Yung, Y.-F., Cheung, M. W.-L., Joo, B.-K., & Nimon, K. (2023). Statistical inference in redundancy analysis: A direct covariance structure modeling approach. *Multivariate Behavioral Research*, **58(5)**, 877-893. doi:10.1080/00273171.2022.2141675

## Examples

```
data(Nimon21)

## Redundancy Analysis
rda(X_vars=c("AU", "CC", "CL", "CO", "DF", "FB", "GR", "MW"),
    Y_vars=c("IDE", "IEE", "IOCB", "IPR", "ITS"),
    data=Nimon21)

## Multivariate Principal Component Regression
mpcr(X_vars=c("AU", "CC", "CL", "CO", "DF", "FB", "GR", "MW"),
     Y_vars=c("IDE", "IEE", "IOCB", "IPR", "ITS"),
     pca="COR", pc_select=1,
     data=Nimon21)
```

## print.CanCorr *Print Method for CanCorr Objects*

### Description

Print method for CanCorr objects.

### Usage

```
## S3 method for class 'CanCorr'
print(x, digits = 4, ...)
```

### Arguments

| | |
|---|---|
| x | An object returned from the class of CanCorr. |
| digits | Number of digits in printing the matrices. The default is 4. |
| ... | Unused. |

### Value

No return value, called for side effects

### Author(s)

Mike W.-L. Cheung mikewlcheung@nus.edu.sg

## print.MPCR *Print Method for MPCR Objects*

### Description

Print method for MPCR objects.

### Usage

```
## S3 method for class 'MPCR'
print(x, digits = 4, ...)
```

### Arguments

| | |
|---|---|
| x | An object returned from the class of MPCR. |
| digits | Number of digits in printing the matrices. The default is 4. |
| ... | Unused. |

## Value

No return value, called for side effects

## Author(s)

Mike W.-L. Cheung mikewlcheung@nus.edu.sg

---

`print.RDA` *Print Method for RDA Objects*

---

## Description

Print method for `RDA` objects.

## Usage

```
## S3 method for class 'RDA'
print(x, digits = 4, ...)
```

## Arguments

| | |
|---|---|
| `x` | An object returned from the class of `RDA`. |
| `digits` | Number of digits in printing the matrices. The default is 4. |
| `...` | Unused. |

## Value

No return value, called for side effects

## Author(s)

Mike W.-L. Cheung mikewlcheung@nus.edu.sg

rda *Redundancy analysis*

## Description

This function conducts redundancy analysis using the OpenMx package. Missing data are handled with the full information maximum likelihood method when raw data are available. It provides standard errors for the standardized estimates.

## Usage

```
rda(
  X_vars,
  Y_vars,
  data = NULL,
  Cov = NULL,
  numObs = NULL,
  extraTries = 50,
  ...
)
```

## Arguments

| | |
|---|---|
| X_vars | A vector of characters of the X variables. |
| Y_vars | A vector of characters of the Y variables. |
| data | A data frame containing raw data. If NULL, Cov and numObs must be provided. |
| Cov | A covariance or correlation matrix. Required when data is NULL. |
| numObs | A sample size. Required when data is NULL. |
| extraTries | This function calls OpenMx::mxTryHard() to obtain parameter estimates and their standard errors. extraTries is the number of extra runs. If extraTries=0, OpenMx::mxRun() is called. |
| ... | Additional arguments passed to either OpenMx::mxTryHard() or OpenMx::mxRun(). |

## Value

A list with class RDA. It stores the model in OpenMx objects. The fitted object is stored in mx.fit.

## Author(s)

Mike W.-L. Cheung mikewlcheung@nus.edu.sg

## References

Gu, F., Yung, Y.-F., Cheung, M. W.-L., Joo, B.-K., & Nimon, K. (2023). Statistical inference in redundancy analysis: A direct covariance structure modeling approach. *Multivariate Behavioral Research*, **58(5)**, 877-893. doi:10.1080/00273171.2022.2141675

## See Also

Chittum19, sas_ex2

## Examples

```
## Redundancy Analysis
rda(X_vars=c("x1", "x2", "x3", "x4"),
    Y_vars=c("y1", "y2", "y3"),
    data=sas_ex2)
```

---

sas_ex1 *Sample data for canonical correlation analysis from the SAS manual*

---

## Description

This dataset includes six variables of fitness club data from the SAS manual.

## Usage

```
sas_ex1
```

## Format

A data frame with 20 rows and 6 variables:

**Weight** Weight measurement

**Waist** Waist measurement

**Pulse** Pulse measurement

**Chins** Number of chin-ups

**Situps** Number of sit-ups

**Jumps** Number of jumps

## Source

https://documentation.sas.com/doc/en/statcdc/14.2/statug/statug_cancorr_example01.htm

## Examples

```
data(sas_ex1)


## Canonical Correlation Analysis
cancorr(X_vars=c("Weight", "Waist", "Pulse"),
        Y_vars=c("Chins", "Situps", "Jumps"),
        data=sas_ex1)
```

## sas_ex2 *Sample data for redundancy analysis from the SAS manual*

### Description

This dataset includes seven variables from the SAS manual.

### Usage

```
sas_ex2
```

### Format

A matrix with 10 rows and 7 columns:

**y1, y2, y3** Y variables

**x1, x2, x3, x4** X variables

### Source

https://documentation.sas.com/doc/en/pgmsascdc/9.4_3.3/statug/statug_transreg_details23.htm

### Examples

```
data(sas_ex2)


## Redundancy Analysis
rda(X_vars=c("x1", "x2", "x3", "x4"),
    Y_vars=c("y1", "y2", "y3"),
    data=sas_ex2)
```

## Thorndike00 *Correlation matrix of a model of disgust*

### Description

This dataset includes a correlation matrix of 13 variables (n=679) between five subscales (y1 to y5) of the Disgust Emotion Scale and eight subscales (x1 to x8) of the Disgust Scale reported by Thorndike (2000, p. 238).

### Usage

```
Thorndike00
```

## Format

A list with the following components:

**data** A 13x13 correlation matrix.

**n** A sample size (679).

## Source

Thorndike, R. M. (2000). Canonical correlation analysis. In H. E. A. Tinsley & S. D. Brown (Eds.), *Handbook of applied multivariate statistics and mathematical modeling* (pp. 237-263). San Diego, CA: Academic Press.

## References

Gu, F., Yung, Y.-F., & Cheung, M. W.-L. (2019). Four covariance structure models for canonical correlation analysis: A COSAN modeling approach. *Multivariate Behavioral Research*, **54(2)**, 192-223. doi:10.1080/00273171.2018.1512847

## Examples

```
data(Thorndike00)

## Canonical Correlation Analysis
## Note. We swap the X_vars and Y_vars because cancorr() expects that
## X_vars cannot have more variables than Y_vars.

cancorr(X_vars=c("y1", "y2", "y3", "y4", "y5"),
        Y_vars=c("x1", "x2", "x3", "x4", "x5", "x6", "x7", "x8"),
        Cov=Thorndike00$data, numObs=Thorndike00$n)
```

# Index