

# Package ‘gtheory’

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**Title** Apply Generalizability Theory with R

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**Description** Estimates variance components, generalizability coefficients, universe scores, and standard errors when observed scores contain variation from one or more measurement facets (e.g., items and raters).

**License** GPL-3

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 gtheory-package

*Apply generalizability theory with R.*


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### Description

gtheory provides functions for estimating variance components, generalizability coefficients, universe scores, and standard errors when observed scores contain variation from one or more measurement facets (e.g., items and raters).

### Details

gtheory was designed to apply univariate and multivariate generalizability (G). Use it to conduct G and decision (D) studies with balanced or unbalanced data. Future releases will provide the means for calculating universe scores under univariate G theory or within strata, as well as universe-score profiles (a.k.a. augmented true scores) and composite scores under multivariate G theory. Functions to find an optimal study design and to calculate conditional error variance are also in the works.

### Author(s)

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### See Also

<http://EvaluationDashboard.com>

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 Brennan.3.2

*Brennan's (2001) Table 3.2*


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### Description

Brennan's (2001) table 3.2 (synthetic data set number 4) contains item scores from a person \* (rater : task) generalizability (G) study. Note that the data are in long format (one item score per row) and the facets are factors.

### Arguments

Brennan.3.2      data frame in long format with a column for item scores and columns for sources of variance

### Source

Brennan, R. L. (2001). *Generalizability theory*. New York: Springer.

**Examples**

```
data(Brennan.3.2)
head(Brennan.3.2)
sapply(Brennan.3.2, class)
```

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dstudy

*Conduct a Univariate or Multivariate Decision (D) Study*


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**Description**

dstudy calculates generalizability and dependability coefficients from variance components. It also provides standards errors of measurement and estimation.

**Usage**

```
dstudy(x, ...)

## S3 method for class 'components'
dstudy(x, colname.objects, ...)

## S3 method for class 'gstudy'
dstudy(x, colname.objects, data = NULL,
       colname.scores = NULL, colname.strata = NULL, weights = NULL, ...)

## S3 method for class 'dstudy'
dstudy(x, colname.objects, weights = NULL, ...)
```

**Arguments**

x	an object of class <code>gstudy</code> , <code>dstudy</code> , or <code>components</code>
...	ignored
colname.objects	a string naming the source of variation for the object of measurement
data	an optional data frame in long format with a column for item scores and columns for sources of variance
colname.scores	an optional string that specifies the name of the column containing scores
colname.strata	an optional string that specifies the name of the column containing strata (if conducting a multivariate G study)
weights	an optional numeric vector containing one weight per stratum for composite scoring (if conducting a multivariate G study); defaults to equal weights

## Details

A typical decision (D) study starts with updating variance components from the generalizability (G) with the number of facet levels from the D-study data. D-study data may or may not be the same data collected for the G study. `dstudy` will update the variance components when you supply decision data and specify the name of the column identifying objects of measurement. If you do not supply data or specify the score column, then `dstudy` will use the G-study variance components (i.e., with all  $n = 1$ ) and return what is commonly known as intraclass correlation (i.e., the generalizability and dependability of a single observation). If your D-study data are unbalanced (i.e., if the number of facet levels vary from one object of measurement to another), then `dstudy` will return an overall components object based on the median number of levels of the main facet effects and will store object-specific variance components as attributes (i.e., to facilitate scoring).

## Value

an object of class "dstudy" that lists the variance components and corresponding measures of signal and noise (i.e., generalizability and dependability coefficients, universe score variance, relative and absolute error variance, and relative and absolute standard errors of measurement and estimation).

## Methods (by class)

- `components`: D study of a components object
- `gstudy`: D study of `gstudy` object
- `dstudy`: D study of a `dstudy` object

## References

- Brennan, R. L. (2001). *Generalizability theory*. New York: Springer.
- Rajaratnam, N., Cronbach, L. J., & Gleser, G. C. (1965). Generalizability of stratified-parallel tests. *Psychometrika*, 30(1), 39-56.

## Examples

```
#A univariate D study.
#Compare to results on page 116 of Brennan (2001).
data(Brennan.3.2)
formula.Brennan.3.2 <- "Score ~ (1 | Person) + (1 | Task) + (1 | Rater:Task) +
  (1 | Person:Task)"
gstudy.out <- gstudy(data = Brennan.3.2, formula = formula.Brennan.3.2)
dstudy(gstudy.out, colname.objects = "Person", data = Brennan.3.2, colname.scores = "Score")

#A multivariate D study.
#Compare to results on pages 270-272 of Brennan (2001).
data(Rajaratnam.2)
formula.Rajaratnam.2 <- "Score ~ (1 | Person) + (1 | Item)"
gstudy.out <- gstudy(data = Rajaratnam.2, formula = formula.Rajaratnam.2,
  colname.strata = "Subtest", colname.objects = "Person")
dstudy(gstudy.out, colname.objects = "Person", data = Rajaratnam.2, colname.scores = "Score",
  colname.strata = "Subtest", weights = c(0.25, 0.5, 0.25))
```

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gstudy

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*Conduct a Univariate or Multivariate Generalizability (G) Study*


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### Description

gstudy estimates variance components attributable to objects of measurement (e.g., persons) and facets (e.g., items and raters), as well as unexplained variation.

### Usage

```
gstudy(data, ...)

## S3 method for class 'data.frame'
gstudy(data, formula, colname.strata = NULL,
        colname.objects = NULL, keep.mer = F, ...)

## S3 method for class 'univariate'
gstudy(data, formula, colname.strata = NULL,
        colname.objects = NULL, keep.mer = F, ...)

## S3 method for class 'multivariate'
gstudy(data, formula, colname.strata = NULL,
        colname.objects = NULL, keep.mer = F, ...)
```

### Arguments

data	a data frame in long format with a column for item scores and columns for sources of variance
...	additional arguments to be passed to <a href="#">lmer</a>
formula	a formula specifying the model to be estimated by <a href="#">lmer</a>
colname.strata	an optional string that specifies the name of the column containing strata (if conducting a multivariate G study)
colname.objects	an optional string that specifies the name of the column containing objects of measurement for calculating observed-score covariance (if conducting a multivariate G study)
keep.mer	a logical indicating whether or not to store the output from <a href="#">lmer</a> as an attribute of the variance components data frame

### Value

an object of class "gstudy" that lists variance components of class "components". It will also list observed-score variance and covariance between strata if you specify the names of the columns identifying strata and objects of measurement.

**Methods (by class)**

- data.frame: G study of a data.frame object
- univariate: G study of a univariate object
- multivariate: G study of a multivariate object

**References**

Brennan, R. L. (2001). *Generalizability theory*. New York: Springer.

Rajaratnam, N., Cronbach, L. J., & Gleser, G. C. (1965). Generalizability of stratified-parallel tests. *Psychometrika*, 30(1), 39-56.

**Examples**

```
#Conduct a univariate G study.
#Compare to results on page 116 of Brennan (2001).
data(Brennan.3.2)
formula.Brennan.3.2 <- "Score ~ (1 | Person) + (1 | Task) +
  (1 | Rater:Task) + (1 | Person:Task)"
gstudy(data = Brennan.3.2, formula = formula.Brennan.3.2)

#Conduct a multivariate G study.
#Compare to results on page 270 of Brennan (2001).
data(Rajaratnam.2)
formula.Rajaratnam.2 <- "Score ~ (1 | Person) + (1 | Item)"
gstudy(data = Rajaratnam.2, formula = formula.Rajaratnam.2, colname.strata = "Subtest",
  colname.objects = "Person")
```

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Rajaratnam.2

*Rajaratnam, Cronbach and Gleser's (1965) Table 2*


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**Description**

Rajaratnam, Cronbach and Gleser's (1965) table 2 contains item scores from a person \* (item : subscale) multivariate generalizability (G) study. The same data are found in Brennan (2001) as table 9.1. Note that the data are in long format (one item score per row) and the facets are factors.

**Arguments**

Rajaratnam.2     data frame in long format with a column for item scores and columns for sources of variance

**Source**

Rajaratnam, N., Cronbach, L. J., & Gleser, G. C. (1965). Generalizability of stratified-parallel tests. *Psychometrika*, 30(1), 39-56.

## References

Brennan, R. L. (2001). *Generalizability theory*. New York: Springer.

## Examples

```
data(Rajaratnam.2)
head(Rajaratnam.2)
sapply(Rajaratnam.2, class)
```

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