

# Package ‘multilevel’

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**Title** Multilevel Functions

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**Description** The functions in this package are designed to be used in the analysis of multi-level data by organizational and social psychologists. The package includes estimates of within-group agreement, and routines using random group resampling (RGR) to detect group effects. The package also contains basic routines for estimating reliability and manipulating data.

**Depends** nlme, MASS

**LazyLoad** yes

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ad.m	<i>Average deviation around mean or median</i>
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### Description

This function calculates the average deviation of the mean or median as a measure of within-group agreement as proposed by Burke, Finkelstein and Dusig (1999). A basic rule for interpreting whether or not the results display practically significant levels of agreement is whether the AD value is smaller than  $A/6$  where  $A$  represents the number of response options. For instance,  $A$  would be 5 on a five-point response option format of strongly disagree, disagree, neither, agree, strongly agree (see Dunlap, Burke & Smith-Crowe, 2003). To estimate statistical significance see the `ad.m.sim` function and help files.

### Usage

```
ad.m(x, grpId, type="mean")
```

**Arguments**

x	A vector representing a single item or a matrix representing a scale of interest. If a matrix, each column of the matrix represents a scale item, and each row represents an individual respondent.
grpId	A vector identifying the groups from which x originated.
type	A character string for either the mean or median.

**Value**

grpId	The group identifier
AD.M	The average deviation around the mean or median for each group
gsize	Group size

**Author(s)**

Paul Bliese <paul.bliese@us.army.mil>

**References**

- Burke, M. J., Finkelstein, L. M., & Dusig, M. S. (1999). On average deviation indices for estimating interrater agreement. *Organizational Research Methods*, 2, 49-68.
- Dunlap, W. P., Burke, M. J., & Smith-Crowe, K. (2003). Accurate tests of statistical significance for rwg and average deviation interrater agreement indices. *Journal of Applied Psychology*, 88, 356-362.

**See Also**

[ad.m.sim](#) [rwg.j](#) [rgr.agree](#) [rwg.sim](#) [rwg.j.sim](#)

**Examples**

```
data(bhr2000)

#Examples for multiple item scales
AD.VAL<-ad.m(bhr2000[,2:12],bhr2000$GRP)
AD.VAL[1:5,]
summary(AD.VAL)
summary(ad.m(bhr2000[,2:12],bhr2000$GRP,type="median"))

#Example for single item measure
summary(ad.m(bhr2000$HRS,bhr2000$GRP))
```

ad.m.sim

*Simulate significance of average deviation around mean or median***Description**

This function uses procedures detailed in Dunlap, Burke, and Smith-Crowe (2003) and Cohen, Doveh, and Nahum-Shani (2009) to estimate the significance of the average deviation of the mean or median (AD.M). Dunlap et al. proposed a strategy to use Monte Carlo techniques to estimate the significance of single item AD.M measures. Cohen et al., (2009) expanded these ideas to cover multiple item scales, ADM(J), and account for correlations among items. The ad.m.sim function is flexible and covers single item or multiple item measures. In the case of multiple item measures, correlations among items can be included (preferred method) or excluded. If item correlations are provided, the MASS library must also be attached. In the Monte Carlo simulations conducted by both Dunlap et al. (2003) and Cohen et al., (2009), 100,000 repetitions were used. In practice, it will require considerable time to perform 100,000 repetitions and in most cases 10,000 should suffice. The examples use 1,000 repetitions simply to speed up the process.

**Usage**

```
ad.m.sim(gsize, nitems=1, nresp, itemcors=NULL, type="mean", nrep)
```

**Arguments**

gsize	Simulated group size.
nitems	Number of items to simulate. The default is 1 for single item measures. If itemcors are provided, this is an optional argument as nitems will be calculated from the correlation matrix, thus it is only necessary for multiple item scales where no correlation matrix is provided.
nresp	The number of response options on the items. For instance, nresp would equal 5 for a 5-point response option of strongly disagree, disagree, neither, agree, strongly agree.
itemcors	An optional matrix providing correlations among items.
type	A character string with either "mean" or "median".
nrep	The number of simulation repetitions.

**Value**

ad.m	Simulated estimates of AD.M values for each of the nrep runs.
gsize	Simulated group size.
nresp	Simulated number of response options.
nitems	Number of items. Either provided in the call (default of 1) or calculated from the correlation matrix, if given.
ad.m.05	Estimated p=.05 value. Observed values equal to or smaller than this value are considered significant.
pract.sig	Estimate of practical significance calculated as nresp/6 (see ad.m).

**Author(s)**

Paul Bliese <paul.bliese@us.army.mil>

**References**

Cohen, A., Doveh, E., & Nahum-Shani, I. (2009). Testing agreement for multi-item scales with the indices rwg(j) and adm(j). *Organizational Research Methods*, 12, 148-164.

Dunlap, W. P., Burke, M. J., & Smith-Crowe, K. (2003). Accurate tests of statistical significance for rwg and average deviation interrater agreement indices. *Journal of Applied Psychology*, 88, 356-362.

**See Also**

[ad.m rgr.agree rwg.sim rwg.j.sim](#)

**Examples**

```
#Example from Dunlap et al. (2003), Table 3. The listed significance
#value (p=.05) for a group of size 5 with a 7-item response format is
#0.64 or less
```

```
SIMOUT<-ad.m.sim(gsize=5, nitems=1, nresp=7, itemcors=NULL,
                 type="mean", nrep=1000)
summary(SIMOUT)
```

```
#Example with a multiple item scale basing item correlations on observed
#correlations among 11 leadership items in the lq2002 data set. Estimate
#in Cohen et al., (2009) is 0.99
```

```
library(MASS)
data(lq2002)
SIMOUT<-ad.m.sim(gsize=10, nresp=5, itemcors=cor(lq2002[,3:13]),
                 type="mean", nrep=1000)
summary(SIMOUT)
quantile(SIMOUT,c(.05,.10))
```

**Description**

This dataset contains the complete data used in Bliese and Halverson (1996). The dataset contains 4 variables. These variables are Cohesion (COHES), Leadership Climate (LEAD), Well-Being (WBEING) and Work Hours (HRS). Each of these variables has two variants – a group mean version that replicates each group mean for every individual, and a within-group version where the group mean is subtracted from each individual response. The group mean version is designated with a G. (e.g., G.HRS), and the within-group version is designated with a W. (e.g., W.HRS).

**Usage**

```
data(bh1996)
```

**Format**

A data frame with 13 columns and 7,382 observations from 99 groups

[,1]	GRP	numeric	Group Identifier
[,2]	COHES	numeric	Cohesion
[,3]	G.COHES	numeric	Average Group Cohesion
[,4]	W.COHES	numeric	Group-Mean Centered Cohesion
[,5]	LEAD	numeric	Leadership
[,6]	G.LEAD	numeric	Average Group Leadership
[,7]	W.LEAD	numeric	Group-Mean Centered Leadership
[,8]	HRS	numeric	Work Hours
[,9]	G.HRS	numeric	Average Group Work Hours
[,10]	W.HRS	numeric	Group-Mean Centered Work Hours
[,11]	WBEING	numeric	Well-Being
[,12]	G.WBEING	numeric	Average Group Well-Being
[,13]	W.WBEING	numeric	Group-Mean Centered Well-Being

**References**

Bliese, P. D. & Halverson, R. R. (1996). Individual and nomothetic models of job stress: An examination of work hours, cohesion, and well-being. *Journal of Applied Social Psychology*, 26, 1171-1189.

---

bhr2000

*Data from Bliese, Halverson and Rothberg (2000)*

---

**Description**

This data set contains the complete data used in Bliese, Halverson & Rothberg (2000). The data set contains 14 variables with individual ratings of US Army Company leadership, work hours, and the degree to which individuals find comfort from religion. The leadership and workhours variables are subsets of the Bliese and Halveson (1996) data set; however, in the case of leadership, the agree data set contains the 11 items that make up the scale whereas the bh1996 data set contains only the scale score. Most items are on a strongly disagree to strongly agree scale. The RELIG item is on a never to always scale.

**Usage**

```
data(bhr2000)
```

**Format**

A data frame with 14 columns and 5,400 observations from 99 groups

[,1]	GRP	numeric	Group Identifier
[,2]	AF06	numeric	Officers get willing and whole-hearted cooperation
[,3]	AF07	numeric	NCOS most always get willing and whole-hearted cooperation
[,4]	AP12	numeric	I am impressed by the quality of leadership in this company
[,5]	AP17	numeric	I would go for help with a personal problem to the chain of command
[,6]	AP33	numeric	Officers in this Company would lead well in combat
[,7]	AP34	numeric	NCOs in this Company would lead well in combat
[,8]	AS14	numeric	My officers are interested in my personal welfare
[,9]	AS15	numeric	My NCOs are interested in my personal welfare
[,10]	AS16	numeric	My officers are interested in what I think and feel about things
[,11]	AS17	numeric	My NCOs are intested in what I think and fell about things
[,12]	AS28	numeric	My chain-of-command works well
[,13]	HRS	numeric	How many hours do you usually work in a day
[,14]	RELIG	numeric	How often do you gain strength of comfort from religious beliefs

## References

Bliese, P. D. & Halverson, R. R. (1996). Individual and nomothetic models of job stress: An examination of work hours, cohesion, and well-being. *Journal of Applied Social Psychology*, 26, 1171-1189.

Bliese, P. D., Halverson, R. R., & Rothberg, J. (2000). Using random group resampling (RGR) to estimate within-group agreement with examples using the statistical language R.

---

cohesion	<i>Five cohesion ratings from 11 individuals nested in 4 platoons in 2 larger units</i>
----------	---

---

## Description

This data set contains five cohesion measures provided by 11 individuals. The individuals providing the measures are members of four platoons further nested within two larger units. This data file is used for demonstrative purposes in the document "Multilevel Modeling in R" that accompanies this package.

## Usage

```
data(cohesion)
```

## Format

A data frame with 7 columns and 11 observations

[,1]	UNIT	numeric	Higher-level Unit Identifier
[,2]	PLATOON	numeric	Lower-level Platoon Identifier
[,3]	COH01	numeric	First Cohesion Variable
[,4]	COH02	numeric	Second Cohesion Variable
[,5]	COH03	numeric	Third Cohesion Variable

[,6]	COH04	numeric	Fourth Cohesion Variable
[,7]	COH05	numeric	Fifth Cohesion Variable

---

cordif

*Estimate whether two independent correlations differ*

---

### Description

This function tests for statistical differences between two independent correlations using the formula provided on page 54 of Cohen & Cohen (1983). The function returns a z-score estimate.

### Usage

```
cordif(rvalue1,rvalue2,n1,n2)
```

### Arguments

rvalue1	Correlation value from first sample.
rvalue2	Correlation value from second sample.
n1	The sample size of the first correlation.
n2	The sample size of the second correlation.

### Value

Produces a single value, the z-score for the differences between the correlations.

### Author(s)

Paul Bliese <paul.bliese@us.army.mil>

### References

Cohen, J. & Cohen, P. (1983). Applied multiple regression/correlation analysis for the behavioral sciences (2nd Ed.). Hillsdale, NJ: Lawrence Erlbaum Associates.

### See Also

[rtoz cordif.dep](#)

### Examples

```
cordif(rvalue1=.51,rvalue2=.71,n1=123,n2=305)
```

---

`cordif.dep`*Estimate whether two dependent correlations differ*

---

**Description**

This function tests for statistical differences between two dependent correlations using the formula provided on page 56 of Cohen & Cohen (1983). The function returns a t-value, the DF and the p-value.

**Usage**

```
cordif.dep(r.x1y,r.x2y,r.x1x2,n)
```

**Arguments**

<code>r.x1y</code>	The correlation between x1 and y where y is typically the outcome variable.
<code>r.x2y</code>	The correlation between x2 and y where y is typically the outcome variable.
<code>r.x1x2</code>	The correlation between x1 and x2 (the correlation between the two predictors).
<code>n</code>	The sample size.

**Value**

Returns three values. A t-value, DF and p-value.

**Author(s)**

Paul Bliese <paul.bliese@us.army.mil>

**References**

Cohen, J. & Cohen, P. (1983). Applied multiple regression/correlation analysis for the behavioral sciences (2nd Ed.). Hillsdale, nJ: Lawrence Erlbaum Associates.

**See Also**

[cordif](#)

**Examples**

```
cordif.dep(r.x1y=.30,r.x2y=.60,r.x1x2=.10,n=305)
```

---

`cronbach`*Estimate Cronbach's Alpha*

---

**Description**

This function calculates the Cronbach's Alpha estimate of reliability for a multi-item scale.

**Usage**

```
cronbach(items)
```

**Arguments**

<code>items</code>	An matrix or data frame where each column represents an item in a multi-item scale.
--------------------	---

**Value**

Alpha	Estimate of Cronbach's Alpha.
N	The number of observations on which the Alpha was estimated.

**Author(s)**

Paul Bliese <paul.bliese@us.army.mil>

**References**

Cronbach L. J. (1951) Coefficient Alpha and the internal structure of tests. *Psychometrika*, 16,297-334

**See Also**

[cronbach](#)

**Examples**

```
data(bhr2000)
cronbach(bhr2000[,2:11])
```

---

GmeanRel	<i>Group Mean Reliability from an lme model (nlme package)</i>
----------	--

---

**Description**

This function calculates the group-mean reliability from a linear mixed effects (lme) model. If group sizes are identical, the group-mean reliability estimate equals the ICC(2) estimate from an ANOVA model. When group sizes differ, however, a group-mean reliability estimate is calculated for each group based on the group size. The group-mean reliability estimate for each group is based upon the Spearman-Brown formula, the overall ICC, and group size for each group.

**Usage**

```
GmeanRel(object)
```

**Arguments**

object	A Linear Mixed Effect (lme) object.
--------	-------------------------------------

**Value**

ICC	Intraclass Correlation Coefficient
Group	A vector containing all the group names.
GrpSize	A vector containing all the group sizes.
MeanRel	A vector containing the group-mean reliability estimate for each group.

**Author(s)**

Paul Bliese <paul.bliese@us.army.mil>

**References**

Bliese, P. D. (2000). Within-group agreement, non-independence, and reliability: Implications for data aggregation and Analysis. In K. J. Klein & S. W. Kozlowski (Eds.), *Multilevel Theory, Research, and Methods in Organizations* (pp. 349-381). San Francisco, CA: Jossey-Bass, Inc.

Bartko, J.J. (1976). On various intraclass correlation reliability coefficients. *Psychological Bulletin*, 83, 762-765.

**See Also**

[ICC1](#) [ICC2](#) [lme](#)

**Examples**

```
data(bh1996)
library(nlme)
tmod<-lme(WBEING~1,random=~1|GRP,data=bh1996)
GmeanRel(tmod)
```

---

`graph.ran.mean`*Graph Random Group versus Actual Group distributions*

---

**Description**

This function uses random group resampling (RGR) to create a distribution of pseudo group means. The pseudo group means are then contrasted with actual group means to provide a visualization of the group-level properties of the data. It is, in essence, a way of visualizing an Intraclass Correlation Coefficient – ICC(1).

**Usage**

```
graph.ran.mean(x, grpId, nreps, limits, graph=TRUE, bootci=FALSE)
```

**Arguments**

<code>x</code>	The vector representing the construct of interest.
<code>grpId</code>	A vector identifying the groups associated with <code>x</code> .
<code>nreps</code>	A number representing the number of random groups to generate. Because groups are created with the exact size characteristics of the actual groups, the total number of pseudo groups created may be calculated as <code>nreps * Number Actual Groups</code> . The value chosen for <code>nreps</code> only affects the smoothness of the pseudo group line – values greater than 25 should provide sufficiently smooth lines. Values of 1000 should be used if the <code>bootci</code> option is TRUE although only 250 are used in the example for speed purposes.
<code>limits</code>	Controls the upper and lower limits of the y-axis on the plot. The default is to set the limits at the 10th and 90th percentiles of the raw data. This option only affects how the data is plotted.
<code>graph</code>	Controls whether or not a plot is returned. If <code>graph=FALSE</code> , the program returns a data frame with two columns. The first column contains the sorted means from the actual groups, and the second column contains the sorted means from the pseudo groups. This can be useful for plotting results in other programs.
<code>bootci</code>	Determines whether approximate 95 percent confidence interval estimates are calculated and plotted. If <code>bootci</code> is TRUE, the <code>nreps</code> option should be 1000 or more.

**Value**

Produces either a plot (`graph=TRUE`) or a `data.frame` (`graph=FALSE`)

**Author(s)**

Paul Bliese <paul.bliese@us.army.mil>

**References**

Bliese, P. D., & Halverson, R. R. (2002). Using random group resampling in multilevel research. *Leadership Quarterly*, 13, 53-68.

**See Also**

[ICC1 mix.data](#)

**Examples**

```
data(bh1996)
with(bh1996, graph.ran.mean(HRS, GRP, limits=c(8,16), nreps=250, bootci=TRUE))
GRAPH.DAT<-graph.ran.mean(bh1996$HRS, bh1996$GRP, limits=c(8,16), nreps=50,
graph=FALSE)
```

---

ICC1

*Function to Estimate Intraclass Correlation Coefficient 1 or ICC(1) from an aov model*

---

**Description**

This function calculates the Intraclass Correlation Coefficient 1 or ICC(1) from an ANOVA model. This value is equivalent to the ICC discussed in the random coefficient modeling literature, and represents the amount of individual-level variance that can be "explained" by group membership.

**Usage**

```
ICC1(object)
```

**Arguments**

object            An ANOVA (aov) object from an one-way analysis of variance.

**Value**

Provides an estimate of ICC(1) for the sample.

**Author(s)**

Paul Bliese <paul.bliese@us.army.mil>

**References**

Bliese, P. D. (2000). Within-group agreement, non-independence, and reliability: Implications for data aggregation and Analysis. In K. J. Klein & S. W. Kozlowski (Eds.), *Multilevel Theory, Research, and Methods in Organizations* (pp. 349-381). San Francisco, CA: Jossey-Bass, Inc.

Bartko, J.J. (1976). On various intraclass correlation reliability coefficients. *Psychological Bulletin*, 83, 762-765.

**See Also**[ICC2 aov](#)**Examples**

```
data(bh1996)
hrs.mod<-aov(HRS~as.factor(GRP),data=bh1996)
ICC1(hrs.mod)
```

---

**ICC2***Function to Estimate Intraclass Correlation Coefficient 2 or ICC(2) from an aov model*

---

**Description**

This function calculates the Intraclass Correlation Coefficient 2 or ICC(2) from an ANOVA model. This value represents the reliability of the group means.

**Usage**

```
ICC2(object)
```

**Arguments**

**object**            An ANOVA (aov) object from an one-way analysis of variance.

**Value**

Provides an estimate of ICC(1) for the sample.

**Author(s)**

Paul Bliese <paul.bliese@us.army.mil>

**References**

Bliese, P. D. (2000). Within-group agreement, non-independence, and reliability: Implications for data aggregation and Analysis. In K. J. Klein & S. W. Kozlowski (Eds.), *Multilevel Theory, Research, and Methods in Organizations* (pp. 349-381). San Francisco, CA: Jossey-Bass, Inc.

Bartko, J.J. (1976). On various intraclass correlation reliability coefficients. *Psychological Bulletin*, 83, 762-765.

**See Also**[ICC1 aov](#)

**Examples**

```
data(bh1996)
hrs.mod<-aov(HRS~as.factor(GRP),data=bh1996)
ICC2(hrs.mod)
```

---

item.total	<i>Item-total correlations</i>
------------	--------------------------------

---

**Description**

This function calculates item-total correlations in multi-item scales.

**Usage**

```
item.total(items)
```

**Arguments**

items	A matrix or dataframe where each column represents an item in a multi-item scale.
-------	---

**Value**

Variable	Variable examined in the reliability analyses.
Item.Total	The item-total correlation.
Alpha.Without	The Cronbach Alpha reliability estimate of the scale without the variable.
N	The number of observations on which the analyses were calculated.

**Author(s)**

Paul Bliese <paul.bliese@us.army.mil>

**References**

Cronbach L. J. (1951) Coefficient Alpha and the internal structure of tests. *Psychometrika*, 16,297-334

**See Also**

[cronbach](#)

**Examples**

```
data(bhr2000)
item.total(bhr2000[,2:11])
```

klein2000

*Data from Klein, Bliese, Kozlowski et al., (2000)***Description**

This data set contains the complete data used in Klein et al. (2000). The Klein et al. chapter uses a simulated data set to compare and contrast WABA, HLM, and Cross-Level Operator Analyses (CLOP). The simulated data set was created by Paul Bliese.

**Usage**

```
data(klein2000)
```

**Format**

A data frame with 9 columns and 750 observations from 50 groups

[,1]	GRPID	numeric	Group Identifier
[,2]	JOBSAT	numeric	Job Satisfaction (DV)
[,3]	COHES	numeric	Cohesion
[,4]	POSAFF	numeric	Positive Affect
[,5]	PAY	numeric	Pay
[,6]	NEGLEAD	numeric	Negative Leadership
[,7]	WLOAD	numeric	Workload
[,8]	TASKSIG	numeric	Task Significance
[,9]	PHYSEN	numeric	Physical Environment

**References**

Klein, K. J., Bliese, P.D., Kozlowski, S. W. J., Dansereau, F., Gavin, M. B., Griffin, M. A., Hofmann, D. A., James, L. R., Yammarino, F. J., & Bligh, M. C. (2000). Multilevel analytical techniques: Commonalities, differences, and continuing questions. In K. J. Klein & S. W. Kozlowski (Eds.), *Multilevel Theory, Research, and Methods in Organizations* (pp. 512-553). San Francisco, CA: Jossey-Bass, Inc

lq2002

*Data used in special issue of Leadership Quarterly, Vol. 13, 2002***Description**

This dataset contains the complete data used in a special issue of *Leadership Quarterly* edited by Paul Bliese, Ronald Halverson and Chet Schriesheim in 2002 (Vol 13). Researchers from several universities analyzed this common dataset using various multilevel techniques. The three scales used in the analyses are Leadership Climate (LEAD), Task Significance (TSIG) and Hostility (HOSTILE). The data set contains each item making up these scales. These items were used by Cohen, Doherty and Nahum-Shani (2009).

**Usage**

data(lq2002)

**Format**

A data frame with 27 columns and 2,042 observations from 49 groups

[,1]	COMPID	numeric	Army Company Identifying Variable
[,2]	SUB	numeric	Subject Number
[,3]	LEAD01	numeric	Officers Get Cooperation From Company (EXV01)
[,4]	LEAD02	numeric	NCOs Get Cooperation From Company (EXV02)
[,5]	LEAD03	numeric	Impressed By Leadership (EXV04)
[,6]	LEAD04	numeric	Go For Help Within Chain of Command (EXV05)
[,7]	LEAD05	numeric	Officers Would Lead Well In Combat (EXV07)
[,8]	LEAD06	numeric	NCOs Would Lead Well In Combat (EXV08)
[,9]	LEAD07	numeric	Officers Interested In Welfare (EXV11)
[,10]	LEAD08	numeric	NCOs Interested In Welfare (EXV13)
[,11]	LEAD09	numeric	Officers Interested In What I Think (EXV14)
[,12]	LEAD10	numeric	NCOs Interested In What I Think (EXV15)
[,13]	LEAD11	numeric	Chain Of Command Works Well (EXV16)
[,14]	TSIG01	numeric	What I Am Doing Is Important (MIS05)
[,15]	TSIG02	numeric	Making Contribution To Mission (MIS06)
[,16]	TSIG03	numeric	What I Am Doing Accomplishes Mission (MIS07)
[,17]	HOSTIL01	numeric	Easily Annoyed Or Irritated (BSI09)
[,18]	HOSTIL02	numeric	Temper Outburst That You Cannot Control (BSI18)
[,19]	HOSTIL03	numeric	Urges To Harm Someone (BSI47)
[,20]	HOSTIL04	numeric	Urges To Break Things (BSI49)
[,21]	HOSTIL05	numeric	Getting Into Frequent Arguments (BSI54)
[,22]	LEAD	numeric	Leadership Climate Scale Score
[,23]	TSIG	numeric	Task Significance Scale Score
[,24]	HOSTILE	numeric	Hostility Scale Score
[,25]	GLEAD	numeric	Leadership Climate Scale Score Aggregated By Company
[,26]	GTSIG	numeric	Task Significance Scale Score Aggregated By Company
[,27]	GHOSTILE	numeric	Hostility Scale Score Aggregated By Company

**References**

Bliese, P. D., & Halverson, R. R. (2002). Using random group resampling in multilevel research. *Leadership Quarterly*, 13, 53-68.

Bliese, P. D., Halverson, R. R., & Schriesheim, C. A. (2002). Benchmarking multilevel methods: Comparing HLM, WABA, SEM, and RGR. *Leadership Quarterly*, 13, 3-14.

Cohen, A., Doveh, E., & Nahum-Shani, I. (2009). Testing agreement for multi-item scales with the indices rwg(j) and adm(j). *Organizational Research Methods*, 12, 148-164.

---

 make.univ

---

*Convert data from multivariate to univariate form*


---

### Description

Longitudinal data is typically stored in multivariate or wide form. In multivariate form, each row contains data from one subject even when the subject provides data at multiple time periods (eg. OUTCOME1, OUTCOME2, OUTCOME3). In the case of repeated measures designs and growth modeling it is necessary to convert the data to univariate or stacked form where each row represents a single time indexed by a variable such as TIME and where each subject has multiple rows of data.

### Usage

```
make.univ(x,dvs,tname="TIME", outname="MULTDV")
```

### Arguments

x	A dataframe in multivariate form.
dvs	A subset dataframe of x containing the repeated measures columns. Note that dvs must be time-ordered from Time 1 to Time N for this function to work properly.
tname	An optional name for the new time variable. Defaults to TIME.
outname	An optional name for the outcome variable name. Defaults to MULTDV.

### Value

Returns a new dataframe in univariate (i.e., stacked) form with a new variable named TIME representing the time intervals and a new variable named MULTDV representing the stacked multiple dependent variables. The TIME variable begins with 0.

### Author(s)

Paul Bliese <paul.bliese@us.army.mil>

### References

Bliese, P. D., & Ployhart, R. E. (2002). Growth modeling using random coefficient models: Model building, testing and illustrations. *Organizational Research Methods*, 5, 362-387.

### Examples

```
data(univbct) #a dataframe in univariate form for job satisfaction
TEMP<-univbct[3*1:495,c(22,1:17)] #convert back to multivariate form

#Transform data to univariate form
TEMP2<-make.univ(x=TEMP,dvs=TEMP[,c(10,13,16)])

#Same as above, but renaming repeated variable
TEMP3<-make.univ(x=TEMP,dvs=TEMP[,c(10,13,16)],outname="JOBSAT")
```

---

mix.data	<i>Randomly mix grouped data</i>
----------	----------------------------------

---

**Description**

This function is called by `graph.ran.mean` (and potentially other functions) to randomly mix data and create new pseudo group ID variables. Pseudo group IDs match real group IDs in terms of size.

**Usage**

```
mix.data(x, grpId)
```

**Arguments**

x	A matrix or vector containing data to be randomly sorted.
grpId	A vector containing a group identifier.

**Value**

newid	A pseudo group ID.
grpId	The real group ID.
x	The values in x arranged as belonging to newid
.	

**Author(s)**

Paul Bliese <paull.bliese@us.army.mil>

**References**

Bliese, P. D., & Halverson, R. R. (2002). Using random group resampling in multilevel research. *Leadership Quarterly*, 13, 53-68.

**See Also**

[graph.ran.mean](#)

**Examples**

```
data(bh1996)
mix.data(x=bh1996[c(1:10, 200:210, 300:310), 2:3],
         grpId=bh1996$GRP[c(1:10, 200:210, 300:310)])
```

---

mult.icc                      *Multiple ICCs from a dataset*

---

### Description

Given a data frame and a group identifier, this function will estimate ICC(1) and ICC(2) values for each column in the dataframe. Note that this function depends upon the nlme package, and it only works with one level of nesting (e.g., students within schools). The dependent variable is assumed to be gaussian.

### Usage

```
mult.icc(x, grpId)
```

### Arguments

x	A data frame containing the variables of interest in each column.
grpId	A vector identifying the groups from which the variables originated.

### Value

Variable	The variable name.
ICC1	The intraclass correlation coefficient 1.
ICC2	The group mean reliability or intraclass correlation coefficient 2.

### Author(s)

Paul Bliese <paul.bliese@us.army.mil>

### References

Bliese, P. D. (2000). Within-group agreement, non-independence, and reliability: Implications for data aggregation and Analysis. In K. J. Klein & S. W. Kozlowski (Eds.), *Multilevel Theory, Research, and Methods in Organizations* (pp. 349-381). San Francisco, CA: Jossey-Bass, Inc.

Bartko, J.J. (1976). On various intraclass correlation reliability coefficients. *Psychological Bulletin*, 83, 762-765.

### See Also

[ICC2](#) [ICC1](#)

### Examples

```
library(nlme)
data(bh1996)
mult.icc(bh1996[,c("HRS", "LEAD", "COHES")], grpId=bh1996$GRP)
```

---

quantile.agree.sim     *S3 method for class 'agree.sim'*

---

## Description

This function provides a concise quantile summary of objects created using the functions `rwg.sim` and `rwg.j.sim`. The simulation functions for `rwg` and `rwg.j` return a limited number of estimated values. Consequently, the normal quantile methods are biased. The quantile methods incorporated in this function produce unbiased estimates.

## Usage

```
## S3 method for class 'agree.sim'  
quantile(x, confint, ...)
```

## Arguments

<code>x</code>	An object of class 'agree.sim'.
<code>confint</code>	The confidence intervals to return. The values of 0.95 and 0.99 return the approximate 95th and 99th percentile confidence intervals (p=.05 and p=.01).
<code>...</code>	Optional arguments. None used.

## Value

A dataframe with two columns. The first column contains the quantile value and the second contains the estimate based on the object.

## Author(s)

Paul Bliese <paul.bliese@us.army.mil>

## See Also

[rwg.sim](#) [rwg.j.sim](#)

## Examples

```
#An example from Dunlap et al. (2003). The estimate from Dunlap et al.  
#Table 2 is 0.53  
RWG.OUT<-rwg.sim(gsize=10,nresp=5,nrep=1000)  
quantile(RWG.OUT, c(.95,.99))
```

---

quantile.disagree.sim *S3 method for class 'disagree.sim'*

---

### Description

This function provides a concise quantile summary of objects created using the function `ad.m.sim`. The simulation functions for the average deviation of the mean (or median) return a limited number of estimated values. Consequently, the normal quantile methods are biased. The quantile methods incorporated in this function produce unbiased estimates.

### Usage

```
## S3 method for class 'disagree.sim'  
quantile(x, confint, ...)
```

### Arguments

<code>x</code>	An object of class 'disagree.sim'.
<code>confint</code>	The confidence intervals to return. The values of 0.05 and 0.01 return the approximate 5 percent and 1 percent confidence intervals. Values equal to or smaller than these values are significant ( $p=.05$ , $p=.01$ ).
<code>...</code>	Optional arguments. None used.

### Value

A dataframe with two columns. The first column contains the quantile value and the second contains the estimate based on the object.

### Author(s)

Paul Bliese <[paul.bliese@us.army.mil](mailto:paul.bliese@us.army.mil)>

### See Also

[ad.m.sim](#)

### Examples

```
#Example from Dunlap et al. (2003), Table 3. The listed significance  
#value ( $p=.05$ ) for a group of size 5 with a 7-item response format is  
#0.64 or less.
```

```
SIMOUT<-ad.m.sim(gsize=5, nitems=1, nresp=7, itemcors=NULL,  
                type="mean", nrep=1000)  
quantile(SIMOUT, c(.05,.01))
```

---

quantile.rgr.waba      *S3 method for class 'rgr.waba'*

---

### Description

This function provides a concise quantile summary of objects created using the function rgr.waba.

### Usage

```
## S3 method for class 'rgr.waba'  
quantile(x, confint, ...)
```

### Arguments

x	An object of class 'rgr.waba'.
confint	The confidence intervals to return. The values of 0.025 and 0.975 return the approximate two-tailed 95th percentile confidence intervals (p=.05).
...	Optional arguments. None used.

### Value

A dataframe containing the confidence intervals for each parameter in the rgr.waba model.

### Author(s)

Paul Bliese <paul.bliese@us.army.mil>

### See Also

[rgr.waba](#)

### Examples

```
data(bh1996)  
  
#estimate the model based on actual group membership  
waba(bh1996$HRS, bh1996$WBEING, bh1996$GRP)  
  
#create 100 pseudo group runs and summarize  
RWABA<-rgr.waba(bh1996$HRS, bh1996$WBEING, bh1996$GRP, 100)  
quantile(RWABA, confint=c(.025, .975))
```

---

`ran.group`*Randomly mix grouped data and return function results*

---

**Description**

This function is called by `rgr.agree` (and potentially other functions). The `ran.group` function randomly mixes data and applies a function to the pseudo groups. Pseudo group IDs match real group IDs in terms of size.

**Usage**

```
ran.group(x,grpId,fun,...)
```

**Arguments**

<code>x</code>	A matrix or vector containing data to be randomly sorted.
<code>grpId</code>	A vector containing a group identifier.
<code>fun</code>	A function to be applied to the observations within each random group.
<code>...</code>	Additional arguments to <code>fun</code> .

**Value**

A vector containing the results of applying the function to each random group.

**Author(s)**

Paul Bliese <paul.bliese@us.army.mil>

**References**

Bliese, P. D., & Halverson, R. R. (2002). Using random group resampling in multilevel research. *Leadership Quarterly*, 13, 53-68.

**See Also**

[rgr.agree](#)

**Examples**

```
data(bh1996)
ran.group(bh1996$HRS,bh1996$GRP,mean)
```

---

rgr.agree

*Random Group Resampling for Within-group Agreement*


---

### Description

This function uses random group resampling (RGR) to estimate within group agreement. RGR agreement compares within group variances from actual groups to within group variances from pseudo groups. Evidence of significant agreement is inferred when variances from the actual groups are significantly smaller than variances from pseudo groups.

### Usage

```
rgr.agree(x, grpId, nrangrps)
```

### Arguments

x	A vector upon which to estimate agreement.
grpId	A vector identifying the groups from which x originated (actual group membership).
nrangrps	A number representing the number of random groups to generate. Note that the number of random groups created must be directly divisible by the number of actual groups to ensure that group sizes of pseudo groups and actual groups are identical. The rgr.agree routine will generate the number of pseudo groups that most closely approximates nrangrps given the group size characteristics of the data.

### Value

An object of class 'rgr.agree' with the following components:

NRanGrp	The number of random groups created.
AvRGRVar	The average within-group variance of the random groups.
SDRGRVar	Standard deviation of random group variances used in the z-score estimate.
zvalue	Z-score difference between the actual group and random group variances.
RGRVARS	The random group variances.

### Author(s)

Paul Bliese <paul.bliese@us.army.mil>

### References

Bliese, P. D., & Halverson, R. R. (2002). Using random group resampling in multilevel research. *Leadership Quarterly*, 13, 53-68.

Bliese, P.D., Halverson, R. R., & Rothberg, J. (2000). Using random group resampling (RGR) to estimate within-group agreement with examples using the statistical language R. Walter Reed Army Institute of Research.

**See Also**[rwg rwg.j](#)**Examples**

```
data(bh1996)
RGROUT<-rgr.agree(bh1996$HRS,bh1996$GRP,1000)
summary(RGROUT)
```

---

`rgr.OLS`*Random Group Resampling OLS Regression*

---

**Description**

This function uses Random Group Resampling (RGR) within an Ordinary Least Square (OLS) framework to allow one to contrast actual group results with pseudo group results. The number of columns in the output matrix of the function (OUT) has to correspond to the number of mean squares you want in the output which in turn is a function of the number of predictors. This specific function does RGR on an OLS hierarchical OLS model with two predictors as in Bliese & Halverson (2002). To run this analysis on data with more predictors, the function will have to be modified.

**Usage**

```
rgr.OLS(xdat1,xdat2,ydata,grpId,nreps)
```

**Arguments**

xdat1	The first predictor.
xdat2	The second predictor.
ydata	The outcome.
grpId	The group identifier.
nreps	The number of pseudo groups to create.

**Value**

A matrix containing mean squares. Each row provides mean square values for a single pseudo group iteration

**Author(s)**

Paul Bliese <paul.bliese@us.army.mil>

**References**

Bliese, P. D., & Halverson, R. R. (2002). Using random group resampling in multilevel research. *Leadership Quarterly*, 13, 53-68.

**See Also**[mix.data](#)**Examples**

```
data(lq2002)
RGROUT<-rgr.OLS(lq2002$LEAD,lq2002$TSIG,lq2002$HOSTILE,lq2002$COMPID,100)

#Compare values to those reported on p.62 in Bliese & Halverson (2002)
summary(RGROUT)
```

---

`rgr.waba`*Random Group Resampling of Covariance Theorem Decomposition*

---

**Description**

This routine performs the covariance theorem decomposition discussed by Robinson (1950) and Dansereau, Alutto and Yammarino (1984), but builds upon this work by incorporating Random Group Resampling or RGR. RGR is used to randomly assign individuals to pseudo groups. This creates sampling distributions of the covariance theorem components, and allows one to contrast actual group covariance components to pseudo group covariance components.

Note that `rgr.waba` is a labor intensive routine.

**Usage**

```
rgr.waba(x, y, grpId, nrep)
```

**Arguments**

<code>x</code>	A vector representing one variable for the correlation.
<code>y</code>	A vector representing the other variable for the correlation.
<code>grpId</code>	A vector identifying the groups from which X and Y originated.
<code>nrep</code>	The number of times that the entire data set is reassigned to pseudo groups

**Value**

Returns an object of class `rgr.waba`. The object is a list containing each random run for each component of the covariance theorem.

**Author(s)**

Paul Bliese <[paul.bliese@us.army.mil](mailto:paul.bliese@us.army.mil)>

## References

- Bliese, P. D. & Halverson, R. R. (1996). Individual and nomothetic models of job stress: An examination of work hours, cohesion, and well-being. *Journal of Applied Social Psychology*, 26, 1171-1189.
- Bliese, P. D., & Halverson, R. R. (2002). Using random group resampling in multilevel research. *Leadership Quarterly*, 13, 53-68.
- Dansereau, F., Alutto, J. A., & Yammarino, F. J. (1984). *Theory testing in organizational behavior: The variant approach*. Englewood Cliffs, NJ: Prentice-Hall.
- Robinson, W. S. (1950). Ecological correlations and the behavior of individuals. *American Sociological Review*, 15, 351-357.

## See Also

[waba](#)

## Examples

```
# This example is from Bliese & Halverson (1996). Notice that all of the
# values from the RGR analysis differ from the values based on actual
# group membership. Confidence intervals for individual components can
# be estimated using the quantile command.
```

```
data(bh1996)
```

```
#estimate the actual group model
waba(bh1996$HRS,bh1996$WBEING,bh1996$GRP)
```

```
#create 100 pseudo group runs and summarize the model
RWABA<-rgr.waba(bh1996$HRS,bh1996$WBEING,bh1996$GRP,100)
summary(RWABA)
```

```
#Estimate 95th percentile confidence intervals (p=.05)
quantile(RWABA,c(.025,.975))
```

---

rtoz

*Conducts an r to z transformation*

---

## Description

This function transforms a correlation (r) to a z variate using the formula provided on page 53 of Cohen & Cohen (1983). The formula is  $z = .5 * ((\log(1+r)) - (\log(1-r)))$  where r is the correlation.

## Usage

```
rtoz(rvalue)
```

**Arguments**

rvalue            The correlation for which one wants the z transformation.

**Value**

Produces a single value, the z transformation.

**Author(s)**

Paul Bliese <paul.bliese@us.army.mil>

**References**

Cohen, J. & Cohen, P. (1983). Applied multiple regression/correlation analysis for the behavioral sciences (2nd Ed.). Hillsdale, NJ: Lawrence Erlbaum Associates.

**See Also**

[cordif](#)

**Examples**

```
rtoz(.84)
```

---

rwg

*James et al., (1984) agreement index for single item measures*

---

**Description**

This function calculates the within group agreement measure rwg for single item measures as described in James, Demaree and Wolf (1984). The rwg is calculated as  $rwg = 1 - (\text{Observed Group Variance} / \text{Expected Random Variance})$ . James et al. (1984) recommend truncating the Observed Group Variance to the Expected Random Variance in cases where the Observed Group Variance was larger than the Expected Random Variance. This truncation results in an rwg value of 0 (no agreement) for groups with large variances.

**Usage**

```
rwg(x, grpId, ranvar=2)
```

**Arguments**

x                    A vector representing the construct on which to estimate agreement.  
 grpId                A vector identifying the groups from which x originated.

ranvar            The random variance to which actual group variances are compared. The value of 2 represents the variance from a rectangular distribution in the case where there are 5 response options (e.g., Strongly Disagree, Disagree, Neither, Agree, Strongly Agree). In cases where there are not 5 response options, the rectangular distribution is estimated using the formula  $\text{ranvar} = (A^2 - 1)/12$  where A is the number of response options. While the rectangular distribution is widely used, other random values may be more appropriate.

### Value

grpId            The group identifier  
 rwg              The rwg estimate for the group  
 gsize            The group size

### Author(s)

Paul Bliese <paul.bliese@us.army.mil>

### References

Bliese, P. D. (2000). Within-group agreement, non-independence, and reliability: Implications for data aggregation and analysis. In K. J. Klein & S. W. Kozlowski (Eds.), *Multilevel Theory, Research, and Methods in Organizations* (pp. 349-381). San Francisco, CA: Jossey-Bass, Inc.

James, L.R., Demaree, R.G., & Wolf, G. (1984). Estimating within-group interrater reliability with and without response bias. *Journal of Applied Psychology*, 69, 85-98.

### See Also

[ad.m.rwg.j](#) [rwg.sim](#) [rgr.agree](#) [rwg.j.lindell](#)

### Examples

```
data(lq2002)
RWGOUT<-rwg(lq2002$LEAD,lq2002$COMPID)
RWGOUT[1:10,]
summary(RWGOUT)
```

---

rwg.j

*James et al., (1984) agreement index for multi-item scales*

---

### Description

This function calculates the within group agreement measure  $\text{rwg}(j)$  for multiple item measures as described in James, Demaree & Wolf (1984).

**Usage**

```
rwg.j(x, grpId, ranvar=2)
```

**Arguments**

x	A matrix representing the scale items. Each column of the matrix represents a separate item, and each row represents an individual respondent.
grpId	A vector identifying the group from which x originated.
ranvar	The random variance to which actual group variances are compared. The value of 2 represents the variance from a rectangular distribution in the case where there are 5 response options (e.g., Strongly Disagree, Disagree, Neither, Agree, Strongly Agree). In cases where there are not 5 response options, the rectangular distribution is estimated using the formula $\text{ranvar} = (A^2 - 1)/12$ where A is the number of response options. Note that one is not limited to the rectangular distribution; rather, one can include any appropriate random value for ranvar.

**Value**

grpId	The group identifier
rwg.j	The rwg(j) estimate for the group
gsize	The group size

**Author(s)**

Paul Bliese <paul.bliese@us.army.mil>

**References**

Bliese, P. D. (2000). Within-group agreement, non-independence, and reliability: Implications for data aggregation and analysis. In K. J. Klein & S. W. Kozlowski (Eds.), *Multilevel Theory, Research, and Methods in Organizations* (pp. 349-381). San Francisco, CA: Jossey-Bass, Inc.

James, L.R., Demaree, R.G., & Wolf, G. (1984). Estimating within-group interrater reliability with and without response bias. *Journal of Applied Psychology*, 69, 85-98.

**See Also**

[ad.m](#) [rwg](#) [rgr](#) [agree](#) [rwg.j.lindell](#) [rwg.j.sim](#)

**Examples**

```
data(lq2002)
RWGOUT<-rwg.j(lq2002[, 3:13], lq2002$COMPID)
RWGOUT[1:10, ]
summary(RWGOUT)
```

---

 rwg.j.lindell

*Lindell et al. r\*wg(j) agreement index for multi-item scales*


---

### Description

This function calculates the Lindell et al r\*wg(j) within-group agreement index for multiple item measures. It is similar to the James, Demaree and Wolf (1984) rwg and rwg(j) indices. The r\*wg(j) index is calculated by taking the average item variability as the Observed Group Variance, and using the average item variability in the numerator of the rwg formula ( $rwg = 1 - (\text{Observed Group Variance} / \text{Expected Random Variance})$ ). In practice, this means that the r\*wg(j) does not increase as the number of items in the scale increases as does the rwg(j). Additionally, the r\*wg(j) allows Observed Group Variances to be larger than Expected Random Variances. In practice this means that r\*wg(j) values can be negative.

### Usage

```
rwg.j.lindell(x, grpId, ranvar=2)
```

### Arguments

x	A matrix representing the scale of interest upon which one is interested in estimating agreement. Each column of the matrix represents a separate scale item, and each row represents an individual respondent.
grpId	A vector identifying the groups from which x originated.
ranvar	The random variance to which actual group variances are compared. The value of 2 represents the variance from a rectangular distribution in the case where there are 5 response options (e.g., Strongly Disagree, Disagree, Neither, Agree, Strongly Agree). In cases where there are not 5 response options, the rectangular distribution is estimated using the formula $ranvar = (A^2 - 1)/12$ where A is the number of response options. Note that one is not limited to the rectangular distribution; rather, one can include any appropriate random value for ranvar.

### Value

grpId	The group identifier
rwg.lindell	The r*wg(j) estimate for the group
gsize	The group size

### Author(s)

Paul Bliese <paul.bliese@us.army.mil>

## References

- James, L.R., Demaree, R.G., & Wolf, G. (1984). Estimating within-group interrater reliability with and without response bias. *Journal of Applied Psychology*, 69, 85-98.
- Lindell, M. K. & Brandt, C. J. (1999). Assessing interrater agreement on the job relevance of a test: A comparison of CVI, T, rWG(J), and r\*WG(J) indexes. *Journal of Applied Psychology*, 84, 640-647.

## See Also

[rwg rwg.j rgr. agree](#)

## Examples

```
data(lq2002)
RWGOUT<-rwg.j.lindell(lq2002[,3:13],lq2002$COMPID)
RWGOUT[1:10,]
summary(RWGOUT)
```

---

rwg.j.sim

*Simulate rwg(j) values from a random null distribution*

---

## Description

This function is based on the work of Cohen, Doveh and Eick (2001) and Cohen, Doveh and Nahum-Shani (2009). The function draws data from a random uniform null distribution, and calculates the James, Demaree and Wolf (1984) within group agreement measure *rwg(j)* for multiple item scales. By repeatedly drawing random samples, a distribution of the *rwg(j)* is generated. The sampling distribution can be used to calculate confidence intervals for different combinations of group sizes and number of items (J). Users provide the number of scale response options (A) and the number of random samples. By default, items (J) drawn in the simulation are independent (non-correlated); however, an optional argument (*itemcors*) allows the user to specify a correlation matrix with relationships among items. Cohen et al. (2001) show that values of *rwg(j)* are primarily a function of the number of items and the group size and are not strongly influenced by correlations among items; nonetheless, assuming correlations among items is more realistic and thereby is a preferred model (see Cohen et al., 2009). If item correlations are provided, the MASS library also needs to be attached.

## Usage

```
rwg.j.sim(gsize, nitems, nresp, itemcors=NULL, nrep)
```

## Arguments

<code>gsize</code>	Group size used in the <i>rwg(j)</i> simulation.
<code>nitems</code>	The number of items (J) in the multi-item scale on which to base the simulation. If <i>itemcors</i> are provided, this is an optional argument as <i>nitems</i> will be calculated from the correlation matrix.

nresp	The number of response options for the J items in the simulation (e.g., there would be 5 response options if using Strongly Disagree, Disagree, Neither, Agree, Strongly Agree).
itemcors	An optional argument containing a correlation matrix with the item correlations.
nrep	The number of rwg(j) values to simulate. This will generally be 10,000 or more, but only 1,000 are used in the examples to increase the speed.

**Value**

rwg.j	rwg(j) value from each of the nrep simulations.
gsize	Simulation group size.
nresp	Simulated number of response options.
nitems	Number of items in the multiple item scale. Either provided in the call or calculated from the correlation matrix, if given.
rwg.j.95	95 percent confidence interval estimate associated with a p-value of .05. Values greater than or equal to the rwg.j.95 value are considered significant.

**Author(s)**

Paul Bliese <paul.bliese@us.army.mil>

**References**

- Cohen, A., Doveh, E., & Nahum-Shani, I. (2009). Testing agreement for multi-item scales with the indices rwg(j) and adm(j). *Organizational Research Methods*, 12, 148-164.
- Cohen, A., Doveh, E., & Eick, U. (2001). Statistical properties of the rwg(j) index of agreement. *Psychological Methods*, 6, 297-310.
- James, L.R., Demaree, R.G., & Wolf, G. (1984). Estimating within-group interrater reliability with and without response bias. *Journal of Applied Psychology*, 69, 85-98.

**See Also**

[rwg.j](#) [rwg](#) [rwg.sim](#) [rwg.j.lindell](#) [rgr.agree](#)

**Examples**

```
#An example assuming independent items
RWG.J.OUT<-rwg.j.sim(gsize=10,nitems=6,nresp=5,nrep=1000)
summary(RWG.J.OUT)
quantile(RWG.J.OUT, c(.95,.99))

#A more realistic example assuming correlated items. The
#estimate in Cohen et al. (2006) is .61.

data(lq2002)
library(MASS)
RWG.J.OUT<-rwg.j.sim(gsize=10,nresp=5,
  itemcors=cor(lq2002[,c("TSIG01","TSIG02","TSIG03")]),
```

```
nrep=1000)
summary(RWG.J.OUT)
quantile(RWG.J.OUT,c(.95,.99))
```

---

 rwg.sim

---

*Simulate rwg values from a random null distribution*


---

## Description

This function is based on the work of Dunlap, Burke & Smith-Crowe (2003). The function draws data from a random uniform null distribution, and calculates the within group agreement measure rwg for single item measures as described in James, Demaree & Wolf (1984). By repeatedly drawing random samples, a distribution of the rwg is generated. The sampling distribution can be used to calculate confidence intervals for different combinations of group sizes and number of response options (A).

## Usage

```
rwg.sim(gsize, nresp, nrep)
```

## Arguments

gsize	Group size upon which to base the rwg simulation.
nresp	The number of response options (e.g., there would be 5 response options if using Strongly Disagree, Disagree, Neither, Agree, Strongly Agree).
nrep	The number of rwg values to simulate. This will generally be 10,000 or more, although the examples use nrep of 1000 to make the calculations fast.

## Value

rwg	rwg value from each simulation.
gsize	Group size used in the rwg simulation.
nresp	Simulated number of response options.
nitems	Will always be 1 for an rwg estimate.
rwg.95	Estimated 95 percent confidence interval. Values greater than or equal to rwg.95 are considered significant, $p < .05$ .

## Author(s)

Paul Bliese <paul.bliese@us.army.mil>

## References

- Cohen, A., Doveh, E., & Eick, U. (2001). Statistical properties of the rwg(j) index of agreement. *Psychological Methods*, 6, 297-310.
- Dunlap, W. P., Burke, M. J., & Smith-Crowe, K. (2003). Accurate tests of statistical significance for rwg and average deviation interrater agreement indices. *Journal of Applied Psychology*, 88, 356-362.
- James, L.R., Demaree, R.G., & Wolf, G. (1984). Estimating within-group interrater reliability with and without response bias. *Journal of Applied Psychology*, 69, 85-98.

## See Also

[ad.m.rwg.j.rwg.rwg.j.sim.rgr.agree](#)

## Examples

```
#An example from Dunlap et al. (2003). The estimate from Dunlap
#et al. Table 2 is 0.53 (p=.05)
RWG.OUT<-rwg.sim(gsize=10,nresp=5,nrep=1000)
summary(RWG.OUT)
quantile(RWG.OUT, c(.95, .99))
```

---

sam.cor

*Generate a Sample that Correlates with a Fixed Set of Observations*

---

## Description

This function will generate a vector (y) with a known correlation to a given vector (x). The degree of correlation between x and y is determined by the parameter rho (the population correlation). Observed sample correlations between x and y will vary around rho, but this variation will decrease as the size of x increases.

## Usage

```
sam.cor(x, rho)
```

## Arguments

x	The given vector.
rho	Population correlation.

## Value

The function prints the sample correlation for the specific set of numbers generated.

y	A vector of numbers correlated with x.
---	--

**Author(s)**

Paul Bliese <paul.bliese@us.army.mil>

**See Also**

[simbias](#)

**Examples**

```
data(bh1996)
NEWVAR<-sam.cor(x=bh1996$LEAD, rho=.30)
cor(bh1996$LEAD, NEWVAR)
```

---

simbias

*Simulate Standard Error Bias in Non-Independent Data*

---

**Description**

Non-independence due to groups is a common characteristic of applied data. In non-independent data, responses from members of the same group are more similar to each other than would be expected by chance. Non-independence is typically measured using the Intraclass Correlation Coefficient 1 or ICC(1). When non-independent data is treated as though it is independent, standard errors will be biased and power can decrease. This simulation allows one to estimate the bias and loss of statistical power that occurs when non-independent data is treated as though it is independent. The simulation contrasts a simple Ordinary Least Squares (OLS) model that fails to account for non-independence with a random coefficient model that accounts for non-independence. The simulation assumes that both the outcome (y) and the predictor (x) vary among individuals in the same group.

**Usage**

```
simbias(corr, gsize, ngrp, icc1x, icc1y, nrep)
```

**Arguments**

corr	The simulated true correlation between x and y.
gsize	The group size from which x and y are drawn.
ngrp	The number of groups.
icc1x	The simulated ICC(1) value for x.
icc1y	The simulated ICC(1) value for y.
nrep	The number of repetitions of simulated data sets.

**Value**

icc1.x	Observed ICC(1) value for x in the simulation.
icc1.y	Observed ICC(1) value for y in the simulation.
lme.coef	Parameter estimate from the lme model.
lme.se	Standard error estimate from the lme model.
lme.tvalue	t-value from the lme model.
lm.coef	Parameter estimate from the linear model (OLS).
lm.se	Standard error estimate from the linear model (OLS).
lm.tvalue	t-value from the linear model (OLS).

**Author(s)**

Paul Bliese <paul.bliese@us.army.mil>

**References**

Bliese, P. D. & Hanges, P. J. (2004). Being both too liberal and too conservative: The perils of treating grouped data as though they were independent. *Organizational Research Methods*, 7, 400-417.

**See Also**

[ICC1](#)

**Examples**

```
library(nlme)
set.seed(15)
SIM.OUTPUT<-simbias(corr=.15,gsize=10,ngroup=50,icc1x=0.05,
                    icc1y=0.35, nrep=100)
apply(SIM.OUTPUT,2,mean)
1-pnorm(1.96-3.39) #Power of the lme model (two-tailed, alpha=.05)
1-pnorm(1.96-2.95) #Power of the OLS model (two-tailed, alpha=.05)
```

---

sobel

*Estimate Sobel's (1982) Test for Mediation*

---

**Description**

Estimate Sobel's (1982) indirect test for mediation. The function provides an estimate of the magnitude of the indirect effect, Sobel's first-order estimate of the standard error associated with the indirect effect, and the corresponding z-value. The estimates are based upon three models as detailed on page 84 of MacKinnon, Lockwood, Hoffman, West and Sheets (2002).

**Usage**

```
sobel(pred, med, out)
```

**Arguments**

pred	The predictor or independent variable.
med	The mediating variable.
out	The outcome or dependent variable.

**Value**

Model.1	A summary of coefficients from Model 1 of MacKinnon et al., (2002).
Model.2	A summary of coefficients from Model 2 of MacKinnon et al., (2002).
Model.3	A summary of coefficients from Model 3 of MacKinnon et al., (2002).
Indirect.Effect	The estimate of the indirect mediating effect.
SE	Sobel's (1982) Standard Error estimate.
z.value	The estimated z-value.
N	The number of observations used in model estimation.

**Author(s)**

Paul Bliese <paul.bliese@us.army.mil>

**References**

MacKinnon, D. P., Lockwood, C. M., Hoffman, J. M., West, S. G., Sheets, V. (2002). A comparison of methods to test mediation and other intervening variable effects. *Psychological Methods*, 7, 83-104.

Sobel, M. E., (1982). Asymptotic confidence intervals for indirect effects in structural equation models. In S. Leinhardt (Ed.), *Sociological Methodology 1982* (pp. 290-312). Washington, DC: American Sociological Association.

**See Also**

[sobel.lme](#)

**Examples**

```
data(bh1996)

#A small but significant indirect effect indicates leadership mediates
#the relationship between work hours and well-being.
sobel(pred=bh1996$HRS, med=bh1996$LEAD, out=bh1996$WBEING)
```

---

sobel.lme

*Estimate Sobel's (1982) Test for Mediation in Two-Level lme Model*


---

### Description

Estimate Sobel's (1982) indirect test for mediation in a two-level linear mixed effects (lme) model. The function provides an estimate of the magnitude of the indirect effect, Sobel's first-order estimate of the standard error associated with the indirect effect, and the corresponding z-value. The estimates are based upon three models as detailed on page 84 of MacKinnon, Lockwood, Hoffman, West and Sheets (2002). By estimating the three models in a two-level lme framework, one can account for the effects of hierarchical nesting in the data, and thereby obtain more accurate estimates of standard errors (see Bliese & Hanges, 2004).

### Usage

```
sobel.lme(pred, med, out, grpId)
```

### Arguments

pred	The predictor or independent variable.
med	The mediating variable.
out	The outcome or dependent variable.
grpId	A variable identifying the groups in which pred, med and out are nested.

### Value

Model.1	Summary of coefficients from Model 1 of MacKinnon et al.
Model.2	Summary of coefficients from Model 2 of MacKinnon et al.
Model.3	Summary of coefficients from Model 3 of MacKinnon et al.
Indirect.Effect	Estimate of indirect mediating effect.
SE	Sobel's (1982) Standard Error estimate.
z.value	The estimated z-value.
N	The number of observations used in model estimation.
n.grps	The number of groups used in model estimation.

### Author(s)

Paul Bliese <paul.bliese@us.army.mil>

## References

Bliese, P. D. & Hanges, P. J. (2004). Being both too liberal and too conservative: The perils of treating grouped data as though they were independent. *Organizational Research Methods*, 7, 400-417.

MacKinnon, D. P., Lockwood, C. M., Hoffman, J. M., West, S. G., Sheets, V. (2002). A comparison of methods to test mediation and other intervening variable effects. *Psychological Methods*, 7, 83-104.

Sobel, M. E., (1982). Asymptotic confidence intervals for indirect effects in structural equation models. In S. Leinhardt (Ed.), *Sociological Methodology 1982* (pp. 290-312). Washington, DC: American Sociological Association.

## See Also

[sobel](#)

## Examples

```
data(bh1996)
library(nlme)

#A small but significant indirect effect indicates leadership mediates
#the relationship between work hours and well-being.

with(bh1996, sobel.lme(pred=HRS,med=LEAD,out=WBEING,grpId=GRP))
```

---

summary.agree.sim      *S3 method for class 'agree.sim'*

---

## Description

This function provides a concise summary of objects created using the functions `rwg.sim` and `rwg.j.sim`.

## Usage

```
## S3 method for class 'agree.sim'
summary(object,...)
```

## Arguments

`object`            An object of class 'agree.sim'.  
`...`                Optional additional arguments. None used.

## Value

A summary of all the output elements in the `agree.sim` class object.

**Author(s)**

Paul Bliese <paul.bliese@us.army.mil>

**See Also**

[rwg.sim](#) [rwg.j.sim](#)

**Examples**

```
#An example from Dunlap et al. (2003). The estimate from Dunlap et al.  
#Table 2 is 0.53  
RWG.OUT<-rwg.sim(gsize=10,nresp=5,nrep=1000)  
summary(RWG.OUT)
```

---

summary.disagree.sim *S3 method for class 'disagree.sim'*

---

**Description**

This function provides a concise summary of objects created using the function ad.m.sim.

**Usage**

```
## S3 method for class 'disagree.sim'  
summary(object,...)
```

**Arguments**

object	An object of class 'disagree.sim'.
...	Optional additional arguments. None used.

**Value**

A summary of all the output elements in the disagree.sim class object.

**Author(s)**

Paul Bliese <paul.bliese@us.army.mil>

**See Also**

[ad.m.sim](#)

**Examples**

```
#Example from Dunlap et al. (2003), Table 3. The listed significance  
#value for a group of size 5 with a 7-item response format is 0.64 or less  
SIMOUT<-ad.m.sim(gsize=5, nitems=1, nresp=7, itemcors=NULL,  
                 type="mean", nrep=1000)  
summary(SIMOUT)
```

---

summary.rgr.agree      *S3 method for class 'rgr.agree'*

---

### Description

This function provides a concise summary of objects created using the function rgr.agree.

### Usage

```
## S3 method for class 'rgr.agree'  
summary(object,...)
```

### Arguments

object            An object of class 'rgr.agree'.  
...                Optional additional arguments. None used.

### Value

Summary Statistics for Random and Real Groups  
    Number of random groups, Average random group variance, Standard Deviation  
    of random group variance, Actual group variance, z-value  
Lower Confidence Intervals (one-tailed)  
    Lower confidence intervals based on sorted random group variances.  
Upper Confidence Intervals (one-Tailed)  
    Upper confidence intervals based on sorted random group variances.

### Author(s)

Paul Bliese <paul.bliese@us.army.mil>

### See Also

[rgr.agree](#)

### Examples

```
data(bh1996)  
RGR0UT<-rgr.agree(bh1996$HRS,bh1996$GRP,1000)  
summary(RGR0UT)
```

---

summary.rgr.waba      *S3 method for class 'rgr.waba'*

---

## Description

This function provides a concise summary of objects created using the function rgr.waba.

## Usage

```
## S3 method for class 'rgr.waba'  
summary(object,...)
```

## Arguments

object	An object of class 'rgr.waba'.
...	Optional additional arguments. None used.

## Value

A dataframe containing summary statistics in the form of number of repetitions (NRep), Mean and Standard Deviations (SD) for each parameter in the rgr.waba model.

## Author(s)

Paul Bliese <paul.bliese@us.army.mil>

## See Also

[rgr.waba](#)

## Examples

```
data(bh1996)  
  
#estimate the actual group model  
waba(bh1996$HRS,bh1996$WBEING,bh1996$GRP)  
  
#create 100 pseudo group runs and summarize results  
RWABA<-rgr.waba(bh1996$HRS,bh1996$WBEING,bh1996$GRP,100)  
summary(RWABA)
```

univbct

*Data from Bliese and Ployhart (2002)***Description**

This data set contains the complete data set used in Bliese and Ployhart (2002). The data is longitudinal data converted to univariate (i.e., stacked) form. Data were collected at three time points.

**Usage**

```
data(univbct)
```

**Format**

A data frame with 22 columns and 1485 observations from 495 individuals

[,1]	BTN	numeric	BN Id
[,2]	COMPANY	numeric	Co Id
[,3]	MARITAL	numeric	Marital Status
[,4]	GENDER	numeric	Gender
[,5]	HOWLONG	numeric	Time in Unit
[,6]	RANK	numeric	Rank
[,7]	EDUCATE	numeric	Education
[,8]	AGE	numeric	Age
[,9]	JOBSAT1	numeric	JOBSAT Time 1
[,10]	COMMIT1	numeric	Commitment Time 1
[,11]	READY1	numeric	Readiness Time 1
[,12]	JOBSAT2	numeric	JOBSAT Time 2
[,13]	COMMIT2	numeric	Commitment Time 2
[,14]	READY2	numeric	Readiness Time 2
[,15]	JOBSAT3	numeric	JOBSAT Time 3
[,16]	COMMIT3	numeric	Commitment Time 3
[,17]	READY3	numeric	Readiness Time 3
[,18]	TIME	numeric	0 to 2 time maker
[,19]	JSAT	numeric	Jobsat in univariate form
[,20]	COMMIT	numeric	Commitment in univariate form
[,21]	READY	numeric	Readiness in univariate form
[,22]	SUBNUM	numeric	Subject number

**References**

Bliese, P. D., & Ployhart, R. E. (2002). Growth modeling using random coefficient models: Model building, testing and illustrations. *Organizational Research Methods*, 5, 362-387.

waba

---

*Covariance Theorem Decomposition of Bivariate Two-Level Correlation*


---

**Description**

This routine performs the covariance theorem decomposition discussed by Robinson (1950) and Dansereau, Alutto and Yammarino (1984). Dansereau et al. have labeled the variance decomposition Within-And-Between-Analysis II or WABA II. The program decomposes a raw correlation from a two-level nested design into 6 components. These components are (1) eta-between value for X, (2) eta-between value for Y, (3) the group-size weighted group-mean correlation, (4) the within-eta value for X, (5) the within-eta value for Y, and (6) the within-group correlation between X and Y. The last value represents the correlation between X and Y after each variable has been group-mean centered.

The program is designed to automatically perform listwise deletion on missing values; consequently, users should pay attention to the diagnostic information (Number of Groups and Number of Observations) provided as part of the output.

Note that Within-And-Between-Analysis proposed by Dansereau et al. involves more than covariance theorem decomposition of correlations. Specifically, WABA involves decision rules based on eta-values. These are not replicated in the R multilevel library because the eta based decision rules have been shown to be highly related to group size (Bliese, 2000; Bliese & Halverson, 1998), a factor not accounted for in the complete Within-And-Between-Analysis methodology.

**Usage**

```
waba(x, y, grpidd)
```

**Arguments**

x	A vector representing one variable in the correlation.
y	A vector representing the other variable in the correlation.
grpidd	A vector identifying the groups from which x and y originated.

**Value**

Returns a list with three elements.

Cov. Theorem	A 1 row dataframe with all of the elements of the covariance theorem.
n. obs	The number of observations used to calculate the covariance theorem.
n. grps	The number of groups in the data set.

**Author(s)**

Paul Bliese <paul.bliese@us.army.mil>

**References**

Bliese, P. D. (2000). Within-group agreement, non-independence, and reliability: Implications for data aggregation and Analysis. In K. J. Klein & S. W. Kozlowski (Eds.), *Multilevel Theory, Research, and Methods in Organizations* (pp. 349-381). San Francisco, CA: Jossey-Bass, Inc.

Bliese, P. D., & Halverson, R. R. (1998). Group size and measures of group-level properties: An examination of eta-squared and ICC values. *Journal of Management*, 24, 157-172.

Dansereau, F., Alutto, J. A., & Yammarino, F. J. (1984). *Theory testing in organizational behavior: The variant approach*. Englewood Cliffs, NJ: Prentice-Hall.

Robinson, W. S. (1950). Ecological correlations and the behavior of individuals. *American Sociological Review*, 15, 351-357.

**See Also**

[rgr.waba](#)

**Examples**

```
data(bh1996)
waba(bh1996$HRS, bh1996$WBEING, bh1996$GRP)
```

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