

# Package ‘BIFIEsurvey’

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**Type** Package

**Title** Tools for Survey Statistics in Educational Assessment

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**Description** Contains tools for survey statistics (especially in educational assessment) for datasets with replication designs (jackknife, bootstrap, replicate weights; see Kolenikov, 2010; Pfefferman & Rao, 2009a, 2009b, <doi:10.1016/S0169-7161(09)70003-3>, <doi:10.1016/S0169-7161(09)70037-9>); Shao, 1996, <doi:10.1080/02331889708802523>). Descriptive statistics, linear and logistic regression, path models for manifest variables with measurement error correction and two-level hierarchical regressions for weighted samples are included. Statistical inference can be conducted for multiply imputed datasets and nested multiply imputed datasets and is in particular suited for the analysis of plausible values (for details see George, Oberwimmer & Itzlinger-Bruneforth, 2016; Bruneforth, Oberwimmer & Robitzsch, 2016; Robitzsch, Pham & Yanagida, 2016; <doi:10.17888/fdb-demo:bistE813I-16a>). This package is developed by BIFIE (Federal Institute for Educational Research, Innovation and Development of the Austrian School System; Salzburg, Austria).

**Depends** R (>= 3.1)

**Imports** graphics, grDevices, methods, miceadds, mitools, Rcpp, stats, survey (>= 3.31-5), utils, TAM (>= 2.0)

**Suggests** car, Hmisc, intsvy, lavaan.survey, lme4, LSAmittR, svyPVpack

**LinkingTo** Rcpp, RcppArmadillo

**License** GPL (>= 2)

**URL** <http://www.bifie.at>,  
<https://www.bifie.at/bildungsforschung/forschungsdatenbibliothek>,  
<https://www.bifie.at/large-scale-assessment-mit-r-methodische-grundlagen-der-oesterreichischen-bildungsstandardueberpr>  
<https://github.com/alexanderrobitzsch/BIFIEsurvey>,  
<https://sites.google.com/site/alexanderrobitzsch2/software>

**NeedsCompilation** yes

**Repository** CRAN

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## R topics documented:

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## Description

Contains tools for survey statistics (especially in educational assessment) for datasets with replication designs (jackknife, bootstrap, replicate weights; see Kolenikov, 2010; Pfefferman & Rao, 2009a, 2009b, <doi:10.1016/S0169-7161(09)70003-3>, <doi:10.1016/S0169-7161(09)70037-9>); Shao, 1996, <doi:10.1080/02331889708802523>). Descriptive statistics, linear and logistic regression, path models for manifest variables with measurement error correction and two-level hierarchical regressions for weighted samples are included. Statistical inference can be conducted for multiply imputed datasets and nested multiply imputed datasets and is in particular suited for the analysis of plausible values (for details see George, Oberwimmer & Itzlinger-Bruneforth, 2016; Bruneforth, Oberwimmer & Robitzsch, 2016; Robitzsch, Pham & Yanagida, 2016; <doi:10.17888/fdb-demo:bistE813I-16a>). This package is developed by BIFIE (Federal Institute for Educational Research, Innovation and Development of the Austrian School System; Salzburg, Austria).

## Details

The **BIFIEsurvey** package include basic descriptive functions for large scale assessment data to complement the more comprehensive **survey** package. The functions in this package were written in **Rcpp**.

The features of **BIFIEsurvey** include for designs with replicate weights (which includes Jackknife and Bootstrap as general approaches):

- Descriptive statistics: means and standard deviations ([BIFIE.univar](#)), frequencies ([BIFIE.freq](#)), crosstabs ([BIFIE.crosstab](#))
- Linear regression ([BIFIE.linreg](#))
- Logistic regression ([BIFIE.logistreg](#))
- Path models with measurement error correction for manifest variables ([BIFIE.pathmodel](#))
- Two-level regression for hierarchical data ([BIFIE.twolevelreg](#); random slope model)
- Statistical inference for derived parameters ([BIFIE.derivedParameters](#))
- Wald tests ([BIFIE.waldtest](#)) of model parameters based on replicated statistics
- User-defined R functions ([BIFIE.by](#))

## Author(s)

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Maintainer: Alexander Robitzsch <robitzsch@ipn.uni-kiel.de>

## References

- Bruneforth, M., Oberwimmer, K., & Robitzsch, A. (2016). Reporting und Analysen. In S. Breit & C. Schreiner (Hrsg.). *Large-Scale Assessment mit R: Methodische Grundlagen der oesterreichischen Bildungsstandardueberpruefung* (S. 333-362). Wien: facultas.
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- Robitzsch, A., Pham, G., & Yanagida, T. (2016). Fehlende Daten und Plausible Values. In S. Breit & C. Schreiner (Hrsg.). *Large-Scale Assessment mit R: Methodische Grundlagen der oesterreichischen Bildungsstandardueberpruefung* (S. 259-293). Wien: facultas.
- Shao, J. (1996). Invited discussion paper: Resampling methods in sample surveys. *Statistics*, 27(3-4), 203-237.

## See Also

See also the **survey**, **intsvy**, **svyPVPack**, **lavaan.survey**, **EVER** and the **eatRep** ([https://r-forge.r-project.org/R/?group\\_id=1326](https://r-forge.r-project.org/R/?group_id=1326)) packages.

## Examples

```
## |-----|
## | BIFIEsurvey 0.1-21 (2014-06-21)
## | Maintainer: Alexander Robitzsch <a.robitzsch at bifie.at >
## | http://www.bifie.at
## |-----|

## .....*,::;                ,::;      * .;*; . ,,:
## :::::::::::::::::::: ##+@      ##+##      .@#####+ ;+# *
## :::::::::::::::::::: ###@      #####      @@;      :*;##**
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## :::::::::::::::::::: ##@# ,@###@      @@## * @@@+##@@@#@      #@      *.#####
## :::::::::::::::::::: #####*#####@.**      #####      @@#####      #@      ;##+*#+@*
## :::::::::::::::::::: ##@#@## ,#+##@      #####      @@      #@      .#@* * *##
## ::,:::#####      ##+@@      #####      #####      #@      #@      ##,      #+*
## :::*#####      ##+@, ** ,###@      #####      #@      #@      @@      ;@;
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## :::*      **...*      ,@#      #####      #####      #@      #@      *@**
```

```
## .....*          ##### @###* ##### #@   #@ *+##*
## .....:,,,:. #####   #####   #@   #@ *##*
## ..... ##### @###   #####   #@   #@ ,##
## ..... #####* @##+   #####   #@   #@ *#@
## .....* @## ,##   #####   #@   #@ @#
## .....* @+##, @###*   #####   #@   #@ *+##
## .....   ###@: *###@   #####   #@   #@ @#+
## .....   **;@##@#####@.   #####   #@   #@ *@#@: * *
## .....   ,#####@.   #####*   ##   @+   #####@##
## .....*   * .##*. *   ***   *.   **   ;##+;
```

BIFIE.BIFIEdata2BIFIEcdata

*Conversion and Selection of BIFIEdata Objects*

**Description**

Functions for converting and selecting objects of class BIFIEdata. The function BIFIE.BIFIEdata2BIFIEcdata converts the BIFIEdata objects in a non-compact form (cdata=FALSE) into an object of class BIFIEdata in a compact form (cdata=TRUE). The function BIFIE.BIFIE2data2BIFIEdata takes the reverse operation.

The function BIFIE.BIFIEdata2datalist converts a (part) of the object of class BIFIEdata into a list of multiply-imputed datasets.

**Usage**

BIFIE.BIFIEdata2BIFIEcdata(bifieobj, varnames=NULL, impdata.index=NULL)

BIFIE.BIFIEcdata2BIFIEdata(bifieobj, varnames=NULL, impdata.index=NULL)

BIFIE.BIFIEdata2datalist(bifieobj, varnames=NULL, impdata.index=NULL)

**Arguments**

- bifieobj            Object of class BIFIEdata
- varnames           Variables chosen for the selection
- impdata.index      Selected indices of imputed datasets

**Value**

An object of class BIFIEdata saved in a non-compact or compact way, see value cdata.

**See Also**

[BIFIE.data](#)

## Examples

```
#####
# EXAMPLE 1: BIFIEdata conversions using data.timss1 dataset
#####
data(data.timss1)
data(data.timssrep)

# create BIFIEdata object
bdat1 <- BIFIEsurvey::BIFIE.data( data.list=data.timss1, wgt=data.timss1[[1]]$TOTWGT,
                                wgtrep=data.timssrep[, -1 ] )
summary(bdat1)

# convert BIFIEdata object bdat1 into a BIFIEcdata object with
# only using the first three datasets and a variable selection
bdat2 <- BIFIEsurvey::BIFIE.BIFIEdata2BIFIEcdata( bifieobj=bdat1,
                                                varnames=bdat1$varnames[ c(1:7,10) ] )

# convert bdat2 into BIFIEdata object and only use the first three imputed datasets
bdat3 <- BIFIEsurvey::BIFIE.BIFIEcdata2BIFIEdata( bifieobj=bdat2, impdata.index=1:3)

# object summaries
summary(bdat1)
summary(bdat2)
summary(bdat3)

## Not run:
#####
# EXAMPLE 2: Extract unique elements in BIFIEdata object
#####

data(data.timss1)
data(data.timssrep)

# create BIFIEdata object
bifieobj <- BIFIEsurvey::BIFIE.data( data.list=data.timss1, wgt=data.timss1[[1]]$TOTWGT,
                                    wgtrep=data.timssrep[, -1 ] )
summary(bifieobj)

# define variables for which unique values should be extracted
vars <- c( "female", "books", "ASMMAT" )
# convert these variables from BIFIEdata object into a list of datasets
bdatlist <- BIFIEsurvey::BIFIE.BIFIEdata2datalist( bifieobj, varnames=vars )
# look for unique values in first dataset for variables
values <- lapply( bdatlist[[1]], FUN=function(vv){
                  sort( unique( vv ) ) } )
# number of unique values in first dataset
Nvalues <- lapply( bdatlist[[1]], FUN=function(vv){
                  length( unique( vv ) ) } )
# number of unique values in all datasets
Nvalues2 <- lapply( vars, FUN=function(vv){
                  #vv <- vars[1]
                  unlist( lapply( bdatlist, FUN=function(dd){
```

```

        length( unique( dd[,vv] ) )
        } ) )
    } )
# --> for extracting the number of unique values using BIFIE.by and a user
#     defined function see Example 1, Model 3 in "BIFIE.by"

## End(Not run)

```

---

BIFIE.by

*Statistics for User Defined Functions*


---

## Description

Computes statistics for user defined functions.

## Usage

```

BIFIE.by( BIFIEobj, vars, userfct, userparnames=NULL,
          group=NULL, group_values=NULL, se=TRUE, use_Rcpp=TRUE)

```

```

## S3 method for class 'BIFIE.by'
summary(object,digits=4,...)

```

```

## S3 method for class 'BIFIE.by'
coef(object,...)

```

```

## S3 method for class 'BIFIE.by'
vcov(object,...)

```

## Arguments

BIFIEobj	Object of class BIFIEdata
vars	Vector of variables for which statistics should be computed
userfct	User defined function. This function must include a matrix X and a weight vector w as arguments. The value of this function must be a vector.
userparnames	An optional vector of parameter names for the value of userfct.
group	Optional grouping variable(s)
group_values	Optional vector of grouping values. This can be omitted and grouping values will be determined automatically.
se	Optional logical indicating whether statistical inference based on replication should be employed.
use_Rcpp	Optional logical indicating whether the user defined function should be evaluated in <b>Rcpp</b> .
object	Object of class BIFIE.by
digits	Number of digits for rounding output
...	Further arguments to be passed

**Value**

A list with following entries

stat	Data frame with statistics defined in userfct
output	Extensive output with all replicated statistics
...	More values

**See Also**

[survey::svyby](#)

**Examples**

```
#####
# EXAMPLE 1: Imputed TIMSS dataset
#####

data(data.timss1)
data(data.timssrep)

# create BIFIE.dat object
bifieobj <- BIFIEsurvey::BIFIE.data( data.list=data.timss1, wgt=data.timss1[[1]]$TOTWGT,
  wgtrep=data.timssrep[, -1 ] )

#####
#*** Model 1: Weighted means (as a toy example)
userfct <- function(X,w){
  pars <- c( stats::weighted.mean( X[,1], w ),
            stats::weighted.mean(X[,2], w ) )
  return(pars)
}
res1 <- BIFIEsurvey::BIFIE.by( bifieobj, vars=c("ASMMAT", "migrant", "books"),
  userfct=userfct, userparnames=c("MW_MAT", "MW_Migr"),
  group="female" )
summary(res1)

# evaluate function in pure R implementation using the use_Rcpp argument
res1b <- BIFIEsurvey::BIFIE.by( bifieobj, vars=c("ASMMAT", "migrant", "books" ),
  userfct=userfct, userparnames=c("MW_MAT", "MW_Migr"),
  group="female", use_Rcpp=FALSE )
summary(res1b)

#--- statistical inference for a derived parameter (see ?BIFIE.derivedParameters)
# define gender difference for mathematics score (divided by 100)
derived.parameters <- list(
  "gender_diff"=~ 0 + I( ( MW_MAT_female1 - MW_MAT_female0 ) / 100 )
)
# inference derived parameter
res1d <- BIFIEsurvey::BIFIE.derivedParameters( res1,
  derived.parameters=derived.parameters )
summary(res1d)
```



```

## Not run:
#####
**** Model 2: Robust linear model

# (1) start from scratch to formulate the user function for X and w
dat1 <- bifieobj$dat1
vars <- c("ASMMAT", "migrant", "books" )
X <- dat1[,vars]
w <- bifieobj$wgt
library(MASS)
# ASMMAT ~ migrant + books
mod <- MASS::rlm( X[,1] ~ as.matrix( X[, -1 ] ), weights=w )
coef(mod)
# (2) define a user function "my_rlm"
my_rlm <- function(X,w){
  mod <- MASS::rlm( X[,1] ~ as.matrix( X[, -1 ] ), weights=w )
  return( coef(mod) )
}
# (3) estimate model
res2 <- BIFIEsurvey::BIFIE.by( bifieobj, vars, userfct=my_rlm,
  group="female", group_values=0:1)
summary(res2)
# estimate model without computing standard errors
res2a <- BIFIEsurvey::BIFIE.by( bifieobj, vars, userfct=my_rlm,
  group="female", se=FALSE)
summary(res2a)

# define a user function with formula language
my_rlm2 <- function(X,w){
  colnames(X) <- vars
  X <- as.data.frame(X)
  mod <- MASS::rlm( ASMMAT ~ migrant + books, weights=w, data=X)
  return( coef(mod) )
}
# estimate model
res2b <- BIFIEsurvey::BIFIE.by( bifieobj, vars, userfct=my_rlm2,
  group="female", group_values=0:1)
summary(res2b)

#####
**** Model 3: Number of unique values for variables in BIFIEdata

*** define variables for which the number of unique values should be calculated
vars <- c( "female", "books", "ASMMAT" )
*** define a user function extracting these unqie values
userfct <- function(X,w){
  pars <- apply( X, 2, FUN=function(vv){
    length( unique(vv)) } )
  # Note that weights are (of course) ignored in this function
  return(pars)
}

```

```

**** extract number of unique values
res3 <- BIFIEsurvey::BIFIE.by( bifieobj, vars=vars, userfct=userfct,
                             userparnames=paste0( vars, "_Nunique"), se=FALSE )
summary(res3)
## Statistical Inference for User Definition Function
##          parm Ncases Nweight  est
## 1 female_Nunique 4668 78332.99  2.0
## 2 books_Nunique  4668 78332.99  5.0
## 3 ASMMAT_Nunique 4668 78332.99 4613.4
# number of unique values in each of the five imputed datasets
res3$output$parsrepM
##          [,1] [,2] [,3] [,4] [,5]
## [1,]      2      2      2      2      2
## [2,]      5      5      5      5      5
## [3,] 4617 4619 4614 4609 4608

*****
**** Model 4: Estimation of a lavaan model with BIFIE.by

#* estimate model in lavaan

data0 <- data.timss1[[1]]
# define lavaan model
lavamodel <- "
  ASSSCI ~ likesc
  ASSSCI ~~ ASSSCI
  likesc ~ female
  likesc ~~ likesc
  female ~~ female
"

mod0 <- lavaan::lavaan(lavamodel, data=data0, sampling.weights="TOTWGT")
summary(mod0, stand=TRUE, fit.measures=TRUE)

#* construct input for BIFIE.by
vars <- c("ASSSCI","likesc","female","TOTWGT")
X <- data0[,vars]
mod0 <- lavaan::lavaan(lavamodel, data=X, sampling.weights="TOTWGT")
w <- data0$TOTWGT

#* define user function
userfct <- function(X,w){
  X1 <- as.data.frame(X)
  colnames(X1) <- vars
  X1$studwgt <- w
  mod0 <- lavaan::lavaan(lavamodel, data=X1, sampling.weights="TOTWGT")
  pars <- coef(mod0)
  # extract some fit statistics
  pars2 <- lavaan::fitMeasures(mod0)
  pars <- c(pars, pars2[c("cfi","tli")])
  return(pars)
}

```

```

#* test function
res0 <- userfct(X,w)
userparnames <- names(res0)

#* estimate lavaan model with replicated sampling weights
res1 <- BIFIEsurvey::BIFIE.by( bifieobj, vars=vars, userfct=userfct,
                             userparnames=userparnames, use_Rcpp=FALSE )
summary(res1)

## End(Not run)

```

---

BIFIE.correl

*Correlations and Covariances*


---

## Description

Computes correlations and covariances

## Usage

```
BIFIE.correl(BIFIEobj, vars, group=NULL, group_values=NULL, se=TRUE)
```

```
## S3 method for class 'BIFIE.correl'
summary(object,digits=4, ...)
```

```
## S3 method for class 'BIFIE.correl'
coef(object,type=NULL, ...)
```

```
## S3 method for class 'BIFIE.correl'
vcov(object,type=NULL, ...)
```

## Arguments

BIFIEobj	Object of class BIFIEdata
vars	Vector of variables for which statistics should be computed
group	Optional grouping variable(s)
group_values	Optional vector of grouping values. This can be omitted and grouping values will be determined automatically.
se	Optional logical indicating whether statistical inference based on replication should be employed.
object	Object of class BIFIE.correl
digits	Number of digits for rounding output
type	If type="cov", then covariances instead of correlations are extracted.
...	Further arguments to be passed

**Value**

A list with following entries

<code>stat.cor</code>	Data frame with correlation statistics
<code>stat.cov</code>	Data frame with covariance statistics
<code>cor_matrix</code>	List of estimated correlation matrices
<code>cov_matrix</code>	List of estimated covariance matrices
<code>output</code>	Extensive output with all replicated statistics
<code>...</code>	More values

**See Also**

[stats::cov.wt](#), [intsvy::timss.rho](#), [intsvy::timss.rho.pv](#), [Hmisc::rcorr](#), [miceadds::ma.wtd.corNA](#)

**Examples**

```
#####
# EXAMPLE 1: Imputed TIMSS dataset
#####

data(data.timss1)
data(data.timssrep)

# create BIFIE.dat object
bdat <- BIFIEsurvey::BIFIE.data( data.list=data.timss1, wgt=data.timss1[[1]]$TOTWGT,
                               wgtrep=data.timssrep[, -1 ] )

# Correlations splitted by gender
res1 <- BIFIEsurvey::BIFIE.correl( bdat, vars=c("lang", "books", "migrant" ),
                                  group="female", group_values=0:1 )
summary(res1)

# Correlations splitted by gender: no statistical inference (se=FALSE)
res1a <- BIFIEsurvey::BIFIE.correl( bdat, vars=c("lang", "books", "migrant" ),
                                   group="female", group_values=0:1, se=FALSE)
summary(res1a)
```

---

BIFIE.crosstab

*Cross Tabulation*

---

**Description**

Creates cross tabulations and computes some effect sizes.

**Usage**

```
BIFIE.crosstab( BIFIEobj, vars1, vars2, vars_values1=NULL, vars_values2=NULL,
               group=NULL, group_values=NULL, se=TRUE )
```

```
## S3 method for class 'BIFIE.crosstab'
summary(object,digits=3,...)
```

```
## S3 method for class 'BIFIE.crosstab'
coef(object,...)
```

```
## S3 method for class 'BIFIE.crosstab'
vcov(object,...)
```

**Arguments**

BIFIEobj	Object of class BIFIEdata
vars1	Row variable
vars2	Column variable
vars_values1	Optional vector of values of variable vars1
vars_values2	Optional vector of values of variable vars2
group	Optional grouping variable(s)
group_values	Optional vector of grouping values. This can be omitted and grouping values will be determined automatically.
se	Optional logical indicating whether statistical inference based on replication should be employed.
object	Object of class BIFIE.univar
digits	Number of digits for rounding output
...	Further arguments to be passed

**Value**

A list with following entries

stat.probs	Statistics for joint and conditional probabilities
stat.marg	Statistics for marginal probabilities
stat.es	Statistics for effect sizes $w$ (based on $\chi^2$ ), Cramers $V$ , Goodman's gamma, the PRE lambda measure and Kruskals tau.
output	Extensive output with all replicated statistics
...	More values

**See Also**

[survey::svytable](#), [Hmisc::wtd.table](#)

## Examples

```
#####
# EXAMPLE 1: Imputed TIMSS dataset
#####

data(data.timss1)
data(data.timssrep)

# create BIFIE.dat object
bifieobj <- BIFIEsurvey::BIFIE.data( data.list=data.timss1, wgt=data.timss1[[1]]$TOTWGT,
                                   wgtrep=data.timssrep[, -1 ] )

#--- Model 1: cross tabulation
res1 <- BIFIEsurvey::BIFIE.crosstab( bieobj, vars1="migrant",
                                   vars2="books", group="female" )
summary(res1)
```

---

BIFIE.data

*Creates an Object of Class BIFIEdata*

---

## Description

This function creates an object of class BIFIEdata. Finite sampling correction of statistical inferences can be conducted by specifying appropriate input in the fayfac argument.

## Usage

```
BIFIE.data(data.list, wgt=NULL, wgtrep=NULL, fayfac=1, pv_vars=NULL,
           pvpre=NULL, cdata=FALSE, NMI=FALSE)
```

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

```
## S3 method for class 'BIFIEdata'
print(x,...)
```

## Arguments

<code>data.list</code>	List of multiply imputed datasets. Can be also a list of list of imputed datasets in case of nested multiple imputation. Then, the argument <code>NMI=TRUE</code> must be specified.
<code>wgt</code>	A string indicating the label of case weight or a vector containing all case weights.
<code>wgtrep</code>	Optional vector of replicate weights
<code>fayfac</code>	Fay factor for calculating standard errors, a numeric value. If finite sampling correction is requested, an appropriate vector input can be used (see Example 3).

<code>pv_vars</code>	Optional vector for names of plausible values, see <a href="#">BIFIE.data.jack</a> .
<code>pvpre</code>	Optional vector for prefixes of plausible values, see <a href="#">BIFIE.data.jack</a> .
<code>cdata</code>	An optional logical indicating whether the BIFIEdata object should be compactly saved. The default is FALSE.
<code>NMI</code>	Optional logical indicating whether <code>data.list</code> is obtained by nested multiple imputation.
<code>object</code>	Object of class BIFIEdata
<code>x</code>	Object of class BIFIEdata
<code>...</code>	Further arguments to be passed

### Value

An object of class BIFIEdata saved in a non-compact or compact way, see value `cdata`. The following entries are included in the list:

<code>datalistM</code>	Stacked list of imputed datasets (if <code>cdata=FALSE</code> )
<code>wgt</code>	Vector with case weights
<code>wgtrep</code>	Matrix with replicate weights
<code>Nimp</code>	Number of imputed datasets
<code>N</code>	Number of observations in a dataset
<code>dat1</code>	Last imputed dataset
<code>varnames</code>	Vector with variable names
<code>fayfac</code>	Fay factor.
<code>RR</code>	Number of replicate weights
<code>NMI</code>	Logical indicating whether the dataset is nested multiply imputed.
<code>cdata</code>	Logical indicating whether the BIFIEdata object is in compact format ( <code>cdata=TRUE</code> ) or in a non-compact format ( <code>cdata=FALSE</code> ).
<code>Nvars</code>	Number of variables
<code>variables</code>	Data frame including some informations about variables. All transformations are saved in the column source.
<code>datalistM_ind</code>	Data frame with response indicators (if <code>cdata=TRUE</code> )
<code>datalistM_imputed</code>	Data frame with imputed values (if <code>cdata=TRUE</code> )

### See Also

See [BIFIE.data.transform](#) for data transformations on BIFIEdata objects.

For saving and loading BIFIEdata objects see [save.BIFIEdata](#).

For converting PIRLS/TIMSS or PISA datasets into BIFIEdata objects see [BIFIE.data.jack](#).

See the [BIFIEdata2svrepdesign](#) function for converting BIFIEdata objects to objects used in the **survey** package.

## Examples

```
#####
# EXAMPLE 1: Create BIFIEdata object with multiply-imputed TIMSS data
#####
data(data.timss1)
data(data.timssrep)

bdat <- BIFIEsurvey::BIFIE.data( data.list=data.timss1, wgt=data.timss1[[1]]$TOTWGT,
                               wgtrep=data.timssrep[, -1 ] )
summary(bdat)
# create BIFIEdata object in a compact way
bdat2 <- BIFIEsurvey::BIFIE.data( data.list=data.timss1, wgt=data.timss1[[1]]$TOTWGT,
                               wgtrep=data.timssrep[, -1 ], cdata=TRUE)
summary(bdat2)

## Not run:
#####
# EXAMPLE 2: Create BIFIEdata object with one dataset
#####
data(data.timss2)

# use first dataset with missing data from data.timss2
bdat <- BIFIEsurvey::BIFIE.data( data.list=data.timss2[[1]], wgt=data.timss2[[1]]$TOTWGT)

## End(Not run)

#####
# EXAMPLE 3: BIFIEdata objects with finite sampling correction
#####

data(data.timss1)
data(data.timssrep)

#-----
# BIFIEdata object without finite sampling correction
bdat1 <- BIFIEsurvey::BIFIE.data( data.list=data.timss1, wgt=data.timss1[[1]]$TOTWGT,
                               wgtrep=data.timssrep[, -1 ] )
summary(bdat1)

#-----
# generate BIFIEdata object with finite sampling correction by adjusting
# the "fayfac" factor
bdat2 <- bdat1
#-- modify "fayfac" constant
fayfac0 <- bdat1$fayfac
# set fayfac=.75 for the first 50 replication zones (25% of students in the
# population were sampled) and fayfac=.20 for replication zones 51-75
# (meaning that 80% of students were sampled)
fayfac <- rep( fayfac0, bdat1$RR )
fayfac[1:50] <- fayfac0 * .75
fayfac[51:75] <- fayfac0 * .20
# include this modified "fayfac" factor in bdat2
```



```

bdat2$fayfac <- fayfac
summary(bdat2)
summary(bdat1)

#---- compare some univariate statistics
# no finite sampling correction
res1 <- BIFIEsurvey::BIFIE.univar( bdat1, vars="ASMMAT")
summary(res1)
# finite sampling correction
res2 <- BIFIEsurvey::BIFIE.univar( bdat2, vars="ASMMAT")
summary(res2)

## Not run:
#####
# EXAMPLE 4: Create BIFIEdata object with nested multiply imputed dataset
#####

data(data.timss4)
data(data.timssrep)

# nested imputed dataset, save it in compact format
bdat <- BIFIEsurvey::BIFIE.data( data.list=data.timss4,
                               wgt=data.timss4[[1]][[1]]$TOTWGT, wgtrep=data.timssrep[, -1 ],
                               NMI=TRUE, cdata=TRUE )
summary(bdat)

## End(Not run)

```

---

BIFIE.data.boot

*Create BIFIE.data Object based on Bootstrap*


---

## Description

Creates a BIFIE.data object based on bootstrap designs. The sampling is done assuming independence of cases.

## Usage

```

BIFIE.data.boot( data, wgt=NULL, pv_vars=NULL,
                 Nboot=500, seed=.Random.seed, cdata=FALSE)

```

## Arguments

data	Data frame: Can be a single or a list of multiply imputed datasets
wgt	A string indicating the label of case weight.
pv_vars	An optional vector of plausible values which define multiply imputed datasets.
Nboot	Number of bootstrap samples for usage
seed	Simulation seed.
cdata	An optional logical indicating whether the BIFIEdata object should be compactly saved. The default is FALSE.

**Value**

Object of class BIFIEdata

**See Also**

[BIFIE.data](#), [BIFIE.data.jack](#)

**Examples**

```
## Not run:
#####
# EXAMPLE 1: Bootstrap TIMSS data set
#####
data(data.timss1)

# bootstrap samples using weights
bifieobj1 <- BIFIEsurvey::BIFIE.data.boot( data.timss1, wgt="TOTWGT" )
summary(bifieobj1)

# bootstrap samples without weights
bifieobj2 <- BIFIEsurvey::BIFIE.data.boot( data.timss1 )
summary(bifieobj2)

## End(Not run)
```

---

BIFIE.data.jack

*Create BIFIE.data Object with Jackknife Zones*

---

**Description**

Creates a BIFIE.data object for designs with jackknife zones, especially for TIMSS/PIRLS and PISA studies.

**Usage**

```
BIFIE.data.jack(data, wgt=NULL, jktype="JK_TIMSS", pv_vars=NULL,
  jkzone=NULL, jkrep=NULL, jkfac=NULL, fayfac=NULL,
  wgtrep="W_FSTR", pvpre=paste0("PV",1:5), ngr=100,
  seed=.Random.seed, cdata=FALSE)
```

**Arguments**

data	Data frame: Can be a single or a list of multiply-imputed datasets
wgt	A string indicating the label of case weight. In case of jktype="JK_TIMSS" the weight is specified as wgt="TOTWGT" as the default.
pv_vars	An optional vector of plausible values which define multiply-imputed datasets.

jktype	Type of jackknife procedure for creating the BIFIE.data object. jktype="JK_TIMSS" refers to TIMSS/PIRLS datasets up to 2011 data, jktype="JK_TIMSS2" refers to TIMSS/PIRLS datasets starting from 2015 data. The type "JK_GROUP" creates jackknife weights based on a user defined grouping, the type "JK_RANDOM" creates random groups. The number of random groups can be defined in ngr. The argument type="RW_PISA" converts PISA datasets into objects of class BIFIEdata.
jkzone	Jackknife zones. If jktype="JK_TIMSS", then jkzone="JKZONE".
jkrep	Jackknife replicate factors. If jktype="JK_TIMSS", then jkrep="JKREP".
jkfac	Factor for multiplying jackknife replicate weights. If jktype="JK_TIMSS", then jkfac=2.
fayfac	Fay factor for statistical inference. The default is set to NULL.
wgtrep	Variables in the dataset which refer to the replicate weights. In case of cdata=TRUE, the replicate weights are deleted from dataListM.
pvpre	Only applicable for jktype="RW_PISA". The vector contains the prefixes of the variables containing plausible values.
ngr	Number of randomly created groups in "JK_RANDOM".
seed	The simulation seed if "JK_RANDOM" is chosen. If seed=NULL, then the grouping is done according the order in the dataset.
cdata	An optional logical indicating whether the BIFIEdata object should be compactly saved. The default is FALSE.

**Value**

Object of class BIFIEdata

**See Also**

[BIFIE.data](#), [BIFIE.data.boot](#)

**Examples**

```
#####
# EXAMPLE 1: Convert TIMSS dataset to BIFIE.data object
#####

data(data.timss3)

# define plausible values
pv_vars <- c("ASMMAT", "ASSSCI" )
# create BIFIE.data objects -> 5 imputed datasets
bdat1 <- BIFIEsurvey::BIFIE.data.jack( data=data.timss3, pv_vars=pv_vars,
                                     jktype="JK_TIMSS" )
summary(bdat1)

# create BIFIE.data objects -> all PVs are included in one dataset
bdat2 <- BIFIEsurvey::BIFIE.data.jack( data=data.timss3, jktype="JK_TIMSS" )
summary(bdat2)
```

```
#####
# EXAMPLE 2: Creation of Jackknife zones and replicate weights for data.test1
#####

data(data.test1)

# create jackknife zones based on random group creation
bdat1 <- BIFIEsurvey::BIFIE.data.jack( data=data.test1, jktype="JK_RANDOM",
                                     ngr=50 )
summary(bdat1)
stat1 <- BIFIEsurvey::BIFIE.univar( bdat1, vars="math", group="stratum" )
summary(stat1)

# random creation of groups and inclusion of weights
bdat2 <- BIFIEsurvey::BIFIE.data.jack( data=data.test1, jktype="JK_RANDOM",
                                     ngr=75, seed=987, wgt="wgtstud")
summary(bdat2)
stat2 <- BIFIEsurvey::BIFIE.univar( bdat2, vars="math", group="stratum" )
summary(stat2)

# using idclass as jackknife zones
bdat3 <- BIFIEsurvey::BIFIE.data.jack( data=data.test1, jktype="JK_GROUP",
                                     jkzone="idclass", wgt="wgtstud")
summary(bdat3)
stat3 <- BIFIEsurvey::BIFIE.univar( bdat3, vars="math", group="stratum" )
summary(stat3)

# create BIFIEdata object with a list of imputed datasets
datalist <- list( data.test1, data.test1, data.test1 )
bdat4 <- BIFIEsurvey::BIFIE.data.jack( data=datalist, jktype="JK_GROUP",
                                     jkzone="idclass", wgt="wgtstud")
summary(bdat4)

## Not run:
#####
# EXAMPLE 3: Converting a PISA dataset into a BIFIEdata object
#####

data(data.pisaNLD)

# BIFIEdata with cdata=FALSE
bifieobj <- BIFIEsurvey::BIFIE.data.jack( data.pisaNLD, jktype="RW_PISA", cdata=FALSE)
summary(bifieobj)
# BIFIEdata with cdata=TRUE
bifieobj1 <- BIFIEsurvey::BIFIE.data.jack( data.pisaNLD, jktype="RW_PISA", cdata=TRUE)
summary(bifieobj1)

## End(Not run)
```

---

**Description**

Computes a data transformation for BIFIEdata objects.

**Usage**

```
BIFIE.data.transform( bifieobj, transform.formula, varnames.new=NULL )
```

**Arguments**

bifieobj            Object of class BIFIEdata  
transform.formula        R formula object for data transformation.  
varnames.new        Optional vector of names for new defined variables.

**Value**

An object of class BIFIEdata. Additional values are

varnames.added    Added variables in data transformation  
varsindex.added    Indices of added variables

**Examples**

```
library(miceadds)

#####
# EXAMPLE 1: Data transformations for TIMSS data
#####

data(data.timss2)
data(data.timssrep)
# create BIFIEdata object
bifieobj1 <- BIFIEsurvey::BIFIE.data( data.timss2, wgt=data.timss2[[1]]$TOTWGT,
  wgtrep=data.timssrep[, -1] )
# create BIFIEdata object in compact way (cdata=TRUE)
bifieobj2 <- BIFIEsurvey::BIFIE.data( data.timss2, wgt=data.timss2[[1]]$TOTWGT,
  wgtrep=data.timssrep[, -1], cdata=TRUE)

#*****
#*** Transformation 1: Squared and cubic book variable
transform.formula <- ~ 0 + I( books^2 ) + I( books^3 )
# as.character(transform.formula)
bifieobj1 <- BIFIEsurvey::BIFIE.data.transform( bifieobj1,
  transform.formula=transform.formula)
bifieobj1$variables
```

```

# rename added variables
bifieobj$varnames[ bifieobj$varsindex.added ] <- c("books_sq", "books_cub")

# check descriptive statistics
res1 <- BIFIEsurvey::BIFIE.univar( bifieobj, vars=c("books_sq", "books_cub" ) )
summary(res1)

## Not run:
#####
### Transformation 2: Create dummy variables for variable book
transform.formula <- ~ 0 + as.factor(books)
bifieobj <- BIFIEsurvey::BIFIE.data.transform( bifieobj,
      transform.formula=transform.formula )
##   Included 5 variables: as.factor(books)1 as.factor(books)2 as.factor(books)3
##   as.factor(books)4 as.factor(books)5
bifieobj$varnames[ bifieobj$varsindex.added ] <- paste0("books_D", 1:5)

#####
### Transformation 3: Discretized mathematics score
hi3a <- BIFIEsurvey::BIFIE.hist( bifieobj, vars="ASMMAT" )
plot(hi3a)
transform.formula <- ~ 0 + I( as.numeric(cut( ASMMAT, breaks=seq(200,800,100) )) )
bifieobj <- BIFIEsurvey::BIFIE.data.transform( bifieobj,
      transform.formula=transform.formula, varnames.new="ASMMAT_discret")
hi3b <- BIFIEsurvey::BIFIE.hist( bifieobj, vars="ASMMAT_discret", breaks=1:7 )
plot(hi3b)
# check frequencies
fr3b <- BIFIEsurvey::BIFIE.freq( bifieobj, vars="ASMMAT_discret", se=FALSE )
summary(fr3b)

#####
### Transformation 4: include standardization variables for book variable

# start with testing the transformation function on a single dataset
dat1 <- bifieobj$dat1
stats::weighted.mean( dat1[, "books"], dat1[, "TOTWGT"], na.rm=TRUE)
sqrt( Hmisc::wtd.var( dat1[, "books"], dat1[, "TOTWGT"], na.rm=TRUE ) )
# z standardization
transform.formula <- ~ 0 + I( ( books - weighted.mean( books, TOTWGT, na.rm=TRUE) ) /
      sqrt( Hmisc::wtd.var( books, TOTWGT, na.rm=TRUE) ))
bifieobj <- BIFIEsurvey::BIFIE.data.transform( bifieobj,
      transform.formula=transform.formula, varnames.new="z_books" )
# standardize variable books with M=500 and SD=100
transform.formula <- ~ 0 + I(
      500 + 100*( books - stats::weighted.mean( books, w=TOTWGT, na.rm=TRUE) ) /
      sqrt( Hmisc::wtd.var( books, weights=TOTWGT, na.rm=TRUE) ) )
bifieobj <- BIFIEsurvey::BIFIE.data.transform( bifieobj,
      transform.formula=transform.formula, varnames.new="z500_books" )

# standardize variable books with respect to M and SD of ALL imputed datasets
res <- BIFIEsurvey::BIFIE.univar( bifieobj, vars="books" )
summary(res)
##   var  Nweight Ncases   M M_SE M_fmi M_VarMI M_VarRep   SD SD_SE SD_fmi

```

```

## 1 books 76588.72 4554 2.945 0.04 0 0 0.002 1.146 0.015 0
M <- round(res$output$mean1,5)
SD <- round(res$output$sd1,5)
transform.formula <- paste0( " ~ 0 + I( ( books - ", M, " ) / ", SD, " )" )
## > transform.formula
## [1] " ~ 0 + I( ( books - 2.94496 ) / 1.14609)"
bifieobj <- BIFIEsurvey::BIFIE.data.transform( bifieobj,
      transform.formula=stats::as.formula(transform.formula),
      varnames.new="zall_books" )

# check statistics
res4 <- BIFIEsurvey::BIFIE.univar( bifieobj,
      vars=c("z_books", "z500_books", "zall_books") )
summary(res4)

#*****
#*** Transformation 5: include rank transformation for variable ASMMAT

# calculate percentage ranks using wtd.rank function from Hmisc package
dat1 <- bifieobj$dat1
100 * Hmisc::wtd.rank( dat1[, "ASMMAT"], w=dat1[, "TOTWGT"] ) / sum( dat1[, "TOTWGT"] )
# define an auxiliary function for calculating percentage ranks
wtd.percrank <- function( x, w ){
  100 * Hmisc::wtd.rank( x, w, na.rm=TRUE ) / sum( w, na.rm=TRUE )
}
wtd.percrank( dat1[, "ASMMAT"], dat1[, "TOTWGT"] )
# define transformation formula
transform.formula <- ~ 0 + I( wtd.percrank( ASMMAT, TOTWGT ) )
# add ranks to BIFIEdata object
bifieobj <- BIFIEsurvey::BIFIE.data.transform( bifieobj,
      transform.formula=transform.formula, varnames.new="ASMMAT_rk" )
# check statistic
res5 <- BIFIEsurvey::BIFIE.univar( bifieobj, vars=c("ASMMAT_rk" ) )
summary(res5)

#*****
#*** Transformation 6: recode variable books

library(car)
# recode variable books according to "1,2=0, 3,4=1, 5=2"
dat1 <- bifieobj$dat1
# use Recode function from car package
car::Recode( dat1[, "books"], "1:2='0'; c(3,4)='1';5='2'" )
# define transformation formula
transform.formula <- ~ 0 + I( car::Recode( books, "1:2='0'; c(3,4)='1';5='2'" ) )
bifieobj <- BIFIEsurvey::BIFIE.data.transform( bifieobj,
      transform.formula=transform.formula, varnames.new="book_rec" )
res6 <- BIFIEsurvey::BIFIE.freq( bifieobj, vars=c("book_rec" ) )
summary(res6)

#*****
#*** Transformation 7: include some variables aggregated to the school level

```

```

dat1 <- as.data.frame(bifieobj$dat1)
# at first, create school ID in the dataset by transforming the student ID
dat1$idschool <- as.numeric(substring( dat1$IDSTUD, 1, 5 ))
transform.formula <- ~ 0 + I( as.numeric( substring( IDSTUD, 1, 5 ) ) )
bifieobj <- BIFIEsurvey::BIFIE.data.transform( bieobj,
      transform.formula=transform.formula, varnames.new="idschool" )

#### test function for a single dataset bieobj$dat1
dat1 <- as.data.frame(bifieobj$dat1)
gm <- miceadds::GroupMean( data=dat1$ASMMAT, group=dat1$idschool, extend=TRUE)[,2]

# add school mean ASMMAT
tformula <- ~ 0 + I( miceadds::GroupMean( ASMMAT, group=idschool, extend=TRUE)[,2] )
bifieobj <- BIFIEsurvey::BIFIE.data.transform( bieobj, transform.formula=tformula,
      varnames.new="M_ASMMAT" )
# add within group centered mathematics values of ASMMAT
bifieobj <- BIFIEsurvey::BIFIE.data.transform( bieobj,
      transform.formula=~ 0 + I( ASMMAT - M_ASMMAT ),
      varnames.new="WC_ASMMAT" )

# add school mean books
bifieobj <- BIFIEsurvey::BIFIE.data.transform( bieobj,
      transform.formula=~ 0 + I( add.groupmean( books, idschool ) ),
      varnames.new="M_books" )

#####
#### Transformation 8: include fitted values and residuals from a linear model
# create new BIFIEdata object
data(data.timss1)
bifieobj3 <- BIFIEsurvey::BIFIE.data( data.timss1, wgt=data.timss1[[1]]$TOTWGT,
      wgtrep=data.timssrep[,-1] )

# specify transformation
transform.formula <- ~ 0 + I( fitted( stats::lm( ASMMAT ~ migrant + female ) ) ) +
      I( residuals( stats::lm( ASMMAT ~ migrant + female ) ) )
# Note that lm omits cases in regression by listwise deletion.
# add fitted values and residual to BIFIEdata object
bifieobj <- BIFIEsurvey::BIFIE.data.transform( bieobj3,
      transform.formula=transform.formula )
bifieobj$varnames[ bieobj$varsindex.added ] <- c("math_fitted1", "math_resid1")

#####
#### Transformation 9: Including principal component scores in BIFIEdata object

# define auxiliary function for extracting PCA scores
BIFIE.princomp <- function( formula, Ncomp ){
  X <- stats::princomp( formula, cor=TRUE)
  Xp <- X$scores[, 1:Ncomp ]
  return(Xp)
}
# define transformation formula
transform.formula <- ~ 0 +
      I( BIFIE.princomp( ~ migrant + female + books + lang + ASMMAT, 3 ) )

```



```

# apply transformation
bifieobj <- BIFIEsurvey::BIFIE.data.transform( bifieobj3,
      transform.formula=transform.formula )
bifieobj$varnames[ bifieobj$varsindex.added ] <- c("pca_sc1", "pca_sc2", "pca_sc3")
# check descriptive statistics
res9 <- BIFIEsurvey::BIFIE.univar( bifieobj, vars="pca_sc1", se=FALSE)
summary(res9)
res9$output$mean1M

# The transformation formula can also be conveniently generated by string operations
vars <- c("migrant", "female", "books", "lang" )
transform.formula2 <- as.formula( paste0( "~ 0 + I ( BIFIE.princomp( ~ ",
      paste0( vars, collapse="+" ), ", 3 ) )" ) )
## > transform.formula2
## ~0 + I(BIFIE.princomp(~migrant + female + books + lang, 3))

#*****
#*** Transformation 10: Overwriting variables books and migrant
bifieobj4 <- BIFIEsurvey::BIFIE.data.transform( bifieobj3,
      transform.formula=~ 0 + I( 1*(books >=1 ) ) + I(2*migrant),
      varnames.new=c("books", "migrant") )
summary(bifieobj4)

## End(Not run)

```

---

BIFIE.derivedParameters

*Statistical Inference for Derived Parameters*

---

## Description

This function performs statistical for derived parameters for objects of classes [BIFIE.by](#), [BIFIE.correl](#), [BIFIE.crosstab](#), [BIFIE.freq](#), [BIFIE.linreg](#), [BIFIE.logistreg](#) and [BIFIE.univar](#).

## Usage

```
BIFIE.derivedParameters( BIFIE.method, derived.parameters, type=NULL)
```

```
## S3 method for class 'BIFIE.derivedParameters'
summary(object,digits=4,...)
```

```
## S3 method for class 'BIFIE.derivedParameters'
coef(object,...)
```

```
## S3 method for class 'BIFIE.derivedParameters'
vcov(object,...)
```



```

# compute correlations
res1 <- BIFIEsurvey::BIFIE.correl( bdat,
                                vars=c("ASSSCI", "ASMMAT", "books", "migrant" ) )
summary(res1)
res1$parnames
## [1] "ASSSCI_ASSSCI" "ASSSCI_ASMMAT" "ASSSCI_books" "ASSSCI_migrant"
## [5] "ASMMAT_ASMMAT" "ASMMAT_books" "ASMMAT_migrant" "books_books"
## [9] "books_migrant" "migrant_migrant"

# define four derived parameters
derived.parameters <- list(
  # squared correlation of science and mathematics
  "R2_sci_mat"=~ 0 + I( 100* ASSSCI_ASMMAT^2 ),
  # partial correlation of science and mathematics controlling for books
  "parcorr_sci_mat"=~ 0 + I( ( ASSSCI_ASMMAT - ASSSCI_books * ASMMAT_books ) /
                             sqrt(( 1 - ASSSCI_books^2 ) * ( 1-ASMMAT_books^2 ) ) ),
  # original correlation science and mathematics (already contained in res1)
  "cor_sci_mat"=~ 0 + I( ASSSCI_ASMMAT ),
  # original correlation books and migrant
  "cor_book_migra"=~ 0 + I( books_migrant )
)

# statistical inference for derived parameters
res2 <- BIFIEsurvey::BIFIE.derivedParameters( res1, derived.parameters )
summary(res2)

```

---

BIFIE.ecdf

*Empirical Distribution Function and Quantiles*


---

## Description

Computes an empirical distribution function (and quantiles). If only some quantiles should be calculated, then an appropriate vector of breaks (which are quantiles) must be specified. Statistical inference is not conducted for this method.

## Usage

```
BIFIE.ecdf( BIFIEobj, vars, breaks=NULL, quanttype=1, group=NULL, group_values=NULL )
```

```
## S3 method for class 'BIFIE.ecdf'
summary(object,digits=4,...)
```

## Arguments

BIFIEobj	Object of class BIFIEdata
vars	Vector of variables for which statistics should be computed.
breaks	Optional vector of breaks. Otherwise, it will be automatically defined.

quanttype	Type of calculation for quantiles. In case of quanttype=1, a linear interpolation is used (which is type='i/n' in <code>Hmisc::wtd.quantile</code> ), while for quanttype=2 no interpolation is used.
group	Optional grouping variable
group_values	Optional vector of grouping values. This can be omitted and grouping values will be determined automatically.
object	Object of class <code>BIFIE.ecdf</code>
digits	Number of digits for rounding output
...	Further arguments to be passed

### Value

A list with following entries

ecdf	Data frame with probabilities and the empirical distribution function (See Examples).
stat	Data frame with empirical distribution function stacked with respect to variables, groups and group values
output	More extensive output
...	More values

### See Also

[Hmisc::wtd.ecdf](#), [Hmisc::wtd.quantile](#)

### Examples

```
#####
# EXAMPLE 1: Imputed TIMSS dataset
#####

data(data.timss1)
data(data.timssrep)

# create BIFIE.dat object
bifieobj <- BIFIEsurvey::BIFIE.data( data.list=data.timss1, wgt=data.timss1[[1]]$TOTWGT,
                                   wgtrep=data.timssrep[, -1 ] )

# ecdf
vars <- c( "ASMMAT", "books" )
group <- "female" ; group_values <- 0:1
# quantile type 1
res1 <- BIFIEsurvey::BIFIE.ecdf( bifieobj, vars=vars, group=group )
summary(res1)
res2 <- BIFIEsurvey::BIFIE.ecdf( bifieobj, vars=vars, group=group, quanttype=2)
# plot distribution function
ecdf1 <- res1$ecdf
plot( ecdf1$ASMMAT_female0, ecdf1$yval, type="l" )
plot( res2$ecdf$ASMMAT_female0, ecdf1$yval, type="l", lty=2)
plot( ecdf1$books_female0, ecdf1$yval, type="l", col="blue" )
```

BIFIE.freq

*Frequency Statistics***Description**

Computes absolute and relative frequencies.

**Usage**

```
BIFIE.freq(BIFIEobj, vars, group=NULL, group_values=NULL, se=TRUE)
```

```
## S3 method for class 'BIFIE.freq'
summary(object,digits=3,...)
```

```
## S3 method for class 'BIFIE.freq'
coef(object,...)
```

```
## S3 method for class 'BIFIE.freq'
vcov(object,...)
```

**Arguments**

BIFIEobj	Object of class BIFIEdata
vars	Vector of variables for which statistics should be computed
group	Optional grouping variable(s)
group_values	Optional vector of grouping values. This can be omitted and grouping values will be determined automatically.
se	Optional logical indicating whether statistical inference based on replication should be employed.
object	Object of class BIFIE.freq
digits	Number of digits for rounding output
...	Further arguments to be passed

**Value**

A list with following entries

stat	Data frame with frequency statistics
output	Extensive output with all replicated statistics
...	More values

**See Also**

[survey::svytable](#), [intsvy::timss.table](#), [Hmisc::wtd.table](#)

## Examples

```
#####
# EXAMPLE 1: Imputed TIMSS dataset
#####

data(data.timss1)
data(data.timssrep)

# create BIFIE.dat object
bdat <- BIFIEsurvey::BIFIE.data( data.list=data.timss1, wgt=data.timss1[[1]]$TOTWGT,
                                wgtrep=data.timssrep[, -1 ] )

# Frequencies for three variables
res1 <- BIFIEsurvey::BIFIE.freq( bdat, vars=c("lang", "books", "migrant" ) )
summary(res1)

# Frequencies splitted by gender
res2 <- BIFIEsurvey::BIFIE.freq( bdat, vars=c("lang", "books", "migrant" ),
                                group="female", group_values=0:1 )
summary(res2)

# Frequencies splitted by gender and likesc
res3 <- BIFIEsurvey::BIFIE.freq( bdat, vars=c("lang", "books", "migrant" ),
                                group=c("likesc","female") )
summary(res3)
```

---

BIFIE.hist

*Histogram*

---

## Description

Computes a histogram with same output as in [graphics::hist](#). Statistical inference is not conducted for this method.

## Usage

```
BIFIE.hist( BIFIEobj, vars, breaks=NULL, group=NULL, group_values=NULL )
```

```
## S3 method for class 'BIFIE.hist'
summary(object,...)
```

```
## S3 method for class 'BIFIE.hist'
plot(x,ask=TRUE,...)
```

## Arguments

BIFIEobj            Object of class BIFIEdata  
vars                Vector of variables for which statistics should be computed.

breaks	Optional vector of breaks. Otherwise, it will be automatically defined.
group	Optional grouping variable(s)
group_values	Optional vector of grouping values. This can be omitted and grouping values will be determined automatically.
object	Object of class BIFIE.hist
x	Object of class BIFIE.hist
ask	Optional logical whether it should be asked for new plots.
...	Further arguments to be passed

**Value**

A list with following entries

histobj	List with objects of class histogram
output	More extensive output
...	More values

**See Also**

[graphics::hist](#)

**Examples**

```
#####
# EXAMPLE 1: Imputed TIMSS dataset
#####

data(data.timss1)
data(data.timssrep)

# create BIFIE.dat object
bifieobj <- BIFIEsurvey::BIFIE.data( data.list=data.timss1, wgt=data.timss1[[1]]$TOTWGT,
                                   wgtrep=data.timssrep[, -1 ] )

# histogram
res1 <- BIFIEsurvey::BIFIE.hist( bifieobj, vars="ASMMAT", group="female" )
# plot histogram for first group (female=0)
plot( res1$histobj$ASMMAT_female0, col="lightblue")
# plot both histograms after each other
plot( res1 )

# user-defined vector of breaks
res2 <- BIFIEsurvey::BIFIE.hist( bifieobj, vars="ASMMAT",
                                 breaks=seq(0,900,10), group="female" )
plot( res2, col="orange")
```

---

BIFIE.linreg                      *Linear Regression*

---

### Description

Computes linear regression.

### Usage

```
BIFIE.linreg(BIFIEobj, dep=NULL, pre=NULL, formula=NULL,
             group=NULL, group_values=NULL, se=TRUE)
```

```
## S3 method for class 'BIFIE.linreg'
summary(object,digits=4,...)
```

```
## S3 method for class 'BIFIE.linreg'
coef(object,...)
```

```
## S3 method for class 'BIFIE.linreg'
vcov(object,...)
```

### Arguments

BIFIEobj	Object of class BIFIEdata
dep	String for the dependent variable in the regression model
pre	Vector of predictor variables. If the intercept should be included, then use the variable one for specifying it (see Examples).
formula	An R formula object which can be applied instead of providing dep and pre. Note that there is additional computation time needed for model matrix creation.
group	Optional grouping variable(s)
group_values	Optional vector of grouping values. This can be omitted and grouping values will be determined automatically.
se	Optional logical indicating whether statistical inference based on replication should be employed.
object	Object of class BIFIE.linreg
digits	Number of digits for rounding output
...	Further arguments to be passed

### Value

A list with following entries

stat	Data frame with unstandardized and standardized regression coefficients, residual standard deviation and $R^2$
output	Extensive output with all replicated statistics
...	More values



**See Also**

[survey::svyglm](#), [intsvy::timss.reg](#), [intsvy::timss.reg.pv](#), [stats::lm](#)

**Examples**

```
#####
# EXAMPLE 1: Imputed TIMSS dataset
#####

data(data.timss1)
data(data.timssrep)

# create BIFIE.dat object
bdat <- BIFIEsurvey::BIFIE.data( data.list=data.timss1, wgt=data.timss1[[1]]$TOTWGT,
                                wgtrep=data.timssrep[, -1 ] )

#**** Model 1: Linear regression for mathematics score
mod1 <- BIFIEsurvey::BIFIE.linreg( bdat, dep="ASMMAT", pre=c("one","books","migrant"),
                                   group="female" )
summary(mod1)

## Not run:
# same model but specified with R formulas
mod1a <- BIFIEsurvey::BIFIE.linreg( bdat, formula=ASMMAT ~ books + migrant,
                                   group="female", group_values=0:1 )
summary(mod1a)

# compare result with lm function and first imputed dataset
dat1 <- data.timss1[[1]]
mod1b <- stats::lm( ASMMAT ~ 0 + as.factor(female) + as.factor(female):books +
                    as.factor(female):migrant,
                    data=dat1, weights=dat1$TOTWGT )
summary(mod1b)

#**** Model 2: Like Model 1, but books is now treated as a factor
mod2 <- BIFIEsurvey::BIFIE.linreg( bdat, formula=ASMMAT ~ as.factor(books) + migrant)
summary(mod2)

#####
# EXAMPLE 2: PISA data | Nonlinear regression models
#####

data(data.pisaNLD)
data <- data.pisaNLD

#--- Create BIFIEdata object immediately using BIFIE.data.jack function
bdat <- BIFIEsurvey::BIFIE.data.jack( data.pisaNLD, jktype="RW_PISA", cdata=TRUE)
summary(bdat)

#*****
#*** Model 1: linear regression
mod1 <- BIFIEsurvey::BIFIE.linreg( bdat, formula=MATH ~ HISEI )
```

```

summary(mod1)

#####
*** Model 2: Cubic regression
mod2 <- BIFIEsurvey::BIFIE.linreg( bdat,
                                formula=MATH ~ HISEI + I(HISEI^2) + I(HISEI^3) )
summary(mod2)

#####
*** Model 3: B-spline regression

# test with design of HISEI values
dfr <- data.frame("HISEI"=16:90 )
des <- stats::model.frame( ~ splines::bs( HISEI, df=5 ), dfr )
des <- des$splines
plot( dfr$HISEI, des[,1], type="l", pch=1, lwd=2, ylim=c(0,1) )
for (vv in 2:ncol(des) ){
  lines( dfr$HISEI, des[,vv], lty=vv, col=vv, lwd=2)
}

# apply B-spline regression in BIFIEsurvey::BIFIE.linreg
mod3 <- BIFIEsurvey::BIFIE.linreg( bdat, formula=MATH ~ splines::bs(HISEI,df=5) )
summary(mod3)

*** include transformed HISEI values for B-spline matrix in bdat
bdat2 <- BIFIEsurvey::BIFIE.data.transform( bdat, ~ 0 + splines::bs( HISEI, df=5 ) )
bdat2$varnames[ bdat2$varsindex.added ] <- paste0("HISEI_bsdes",
                                                seq( 1, length( bdat2$varsindex.added ) ) )

#####
*** Model 4: Nonparametric regression using BIFIE.by

?BIFIE.by

#---- (1) test function with one dataset
dat1 <- bdat$dat1
vars <- c("MATH", "HISEI")
X <- dat1[,vars]
w <- bdat$wgt
X <- as.data.frame(X)
# estimate model
mod <- stats::loess( MATH ~ HISEI, weights=w, data=X )

# predict HISEI values
hisei_val <- data.frame( "HISEI"=seq(16,90) )
y_pred <- stats::predict( mod, hisei_val )
graphics::plot( hisei_val$HISEI, y_pred, type="l" )

#-- (2) define loess function
loess_fct <- function(X,w){
  X1 <- data.frame( X, w )
  colnames(X1) <- c( vars, "wgt" )
  X1 <- stats::na.omit(X1)
}

```

```

#   mod <- stats::lm( MATH ~ HISEI, weights=X1$wgt, data=X1 )
#   mod <- stats::loess( MATH ~ HISEI, weights=X1$wgt, data=X1 )
#   y_pred <- stats::predict( mod, hisei_val )
#   return(y_pred)
}

#--- (3) estimate model
mod4 <- BIFIEsurvey::BIFIE.by( bdat, vars, userfct=loess_fct )
summary(mod4)

# plot linear function pointwise and confidence intervals
graphics::plot( hisei_val$HISEI, mod4$stat$est, type="l", lwd=2,
                xlab="HISEI", ylab="PVMATH", ylim=c(430,670) )
graphics::lines( hisei_val$HISEI, mod4$stat$est - 1.96* mod4$stat$SE, lty=3 )
graphics::lines( hisei_val$HISEI, mod4$stat$est + 1.96* mod4$stat$SE, lty=3 )

## End(Not run)

```

---

BIFIE.logistreg

*Logistic Regression*


---

## Description

Computes logistic regression.

## Usage

```

BIFIE.logistreg(BIFIEobj, dep=NULL, pre=NULL, formula=NULL,
               group=NULL, group_values=NULL, se=TRUE, eps=1E-8, maxiter=100)

```

```

## S3 method for class 'BIFIE.logistreg'
summary(object,digits=4,...)

```

```

## S3 method for class 'BIFIE.logistreg'
coef(object,...)

```

```

## S3 method for class 'BIFIE.logistreg'
vcov(object,...)

```

## Arguments

BIFIEobj	Object of class BIFIEdata
dep	String for the dependent variable in the regression model
pre	Vector of predictor variables. If the intercept should be included, then use the variable one for specifying it (see Examples).
formula	An R formula object which can be applied instead of providing dep and pre. Note that there is additional computation time needed for model matrix creation.

group	Optional grouping variable(s)
group_values	Optional vector of grouping values. This can be omitted and grouping values will be determined automatically.
se	Optional logical indicating whether statistical inference based on replication should be employed.
eps	Convergence criterion for parameters
maxiter	Maximum number of iterations
object	Object of class BIFIE.logistreg
digits	Number of digits for rounding output
...	Further arguments to be passed

### Value

A list with following entries

stat	Data frame with regression coefficients
output	Extensive output with all replicated statistics
...	More values

### See Also

[survey::svyglm](#), [stats::glm](#)

For linear regressions see [BIFIE.linreg](#).

### Examples

```
#####
# EXAMPLE 1: TIMSS dataset | Logistic regression
#####

data(data.timss2)
data(data.timssrep)

# create BIFIE.dat object
bdat <- BIFIEsurvey::BIFIE.data( data.list=data.timss2, wgt=data.timss2[[1]]$TOTWGT,
                               wgtrep=data.timssrep[, -1 ] )

####* Model 1: Logistic regression - prediction of migrational background
res1 <- BIFIEsurvey::BIFIE.logistreg( BIFIEobj=bdat, dep="migrant",
                                     pre=c("one","books","lang"), group="female", se=FALSE )
summary(res1)

## Not run:
# same model, but with formula specification and standard errors
res1a <- BIFIEsurvey::BIFIE.logistreg( BIFIEobj=bdat,
                                       formula=migrant ~ books + lang, group="female" )
summary(res1a)
```

```
#####
# SIMULATED EXAMPLE 2: Comparison of stats::glm and BIFIEsurvey::BIFIE.logistreg
#####

*** (1) simulate data
set.seed(987)
N <- 300
x1 <- stats::rnorm(N)
x2 <- stats::runif(N)
ypred <- -0.75+.2*x1 + 3*x2
y <- 1*( stats::plogis(ypred) > stats::runif(N) )
data <- data.frame( "y"=y, "x1"=x1, "x2"=x2 )

*** (2) estimation logistic regression using glm
mod1 <- stats::glm( y ~ x1 + x2, family="binomial")

*** (3) estimation logistic regression using BIFIEdata
# create BIFIEdata object by defining 30 Jackknife zones
bifiedata <- BIFIEsurvey::BIFIE.data.jack( data, jktype="JK_RANDOM", ngr=30 )
summary(bifiedata)
# estimate logistic regression
mod2 <- BIFIEsurvey::BIFIE.logistreg( bifiedata, formula=y ~ x1+x2 )

*** (4) compare results
summary(mod2) # BIFIE.logistreg
summary(mod1) # glm

## End(Not run)
```

---

BIFIE.mva

*Missing Value Analysis*


---

## Description

Conducts a missing value analysis.

## Usage

```
BIFIE.mva( BIFIEobj, missvars, covariates=NULL, se=TRUE )
```

```
## S3 method for class 'BIFIE.mva'
summary(object,digits=4,...)
```

## Arguments

BIFIEobj	Object of class BIFIEdata
missvars	Vector of variables for which missing value statistics should be computed
covariates	Vector of variables which work as covariates

se	Optional logical indicating whether statistical inference based on replication should be employed.
object	Object of class BIFIE.correl
digits	Number of digits for rounding output
...	Further arguments to be passed

### Value

A list with following entries

stat.mva	Data frame with missing value statistics
res_list	List with extensive output split according to each variable in missvars
...	More values

### Examples

```
#####
# EXAMPLE 1: Imputed TIMSS dataset
#####

data(data.timss1)
data(data.timsrep)

# create BIFIE.dat object
BIFIEdata <- BIFIEsurvey::BIFIE.data( data.list=data.timss1,
                                     wgt=data.timss1[[1]]$TOTWGT, wgtrep=data.timsrep[, -1 ] )

# missing value analysis for "scsci" and "books" and three covariates
res1 <- BIFIEsurvey::BIFIE.mva( BIFIEdata, missvars=c("scsci", "books" ),
                               covariates=c("ASMMAT", "female", "ASSSCI") )
summary(res1)

# missing value analysis without statistical inference and without covariates
res2 <- BIFIEsurvey::BIFIE.mva( BIFIEdata, missvars=c("scsci", "books"), se=FALSE)
summary(res2)
```

---

BIFIE.pathmodel

*Path Model Estimation*

---

### Description

This function computes a path model. Predictors are allowed to possess measurement errors. Known measurement error variances (and covariances) or reliabilities can be specified by the user. Alternatively, a set of indicators can be defined for each latent variable, and for each imputed and replicated dataset the measurement error variance is determined by means of calculating the reliability Cronbachs alpha. Measurement errors are handled by adjusting covariance matrices (see Buonaccorsi, 2010, Ch. 5).

**Usage**

```

BIFIE.pathmodel( BIFIEobj, lavaan.model, reliability=NULL, group=NULL,
                 group_values=NULL, se=TRUE )

## S3 method for class 'BIFIE.pathmodel'
summary(object,digits=4,...)

## S3 method for class 'BIFIE.pathmodel'
coef(object,...)

## S3 method for class 'BIFIE.pathmodel'
vcov(object,...)

```

**Arguments**

BIFIEobj	Object of class BIFIEdata
lavaan.model	String including the model specification in <b>lavaan</b> syntax. lavaan.model also allows the extended functionality in the <a href="#">TAM:lavaanify.IRT</a> function.
reliability	Optional vector containing the reliabilities of each variable. This vector can also include only a subset of all variables.
group	Optional grouping variable(s)
group_values	Optional vector of grouping values. This can be omitted and grouping values will be determined automatically.
se	Optional logical indicating whether statistical inference based on replication should be employed.
object	Object of class BIFIE.pathmodel
digits	Number of digits for rounding output
...	Further arguments to be passed

**Details**

The following conventions are used as parameter labels in the output.

$Y \sim X$  is the regression coefficient of the regression from  $Y$  on  $X$ .

$X \rightarrow Z \rightarrow Y$  denotes the path coefficient from  $X$  to  $Y$  passing the mediating variable  $Z$ .

$X \rightarrow+ Y$  denotes the total effect (of all paths) from  $X$  to  $Y$ .

$X \rightarrow\sim Y$  denotes the sum of all indirect effects from  $X$  to  $Y$ .

The parameter suffix `_stand` refers to parameters for which all variables are standardized.

**Value**

A list with following entries

stat	Data frame with unstandardized and standardized regression coefficients, path coefficients, total and indirect effects, residual variances, and $R^2$
output	Extensive output with all replicated statistics
...	More values

## References

Buonaccorsi, J. P. (2010). *Measurement error: Models, methods, and applications*. CRC Press.

## See Also

See the **lavaan** and **lavaan.survey** package.

For the lavaan syntax, see [lavaan::lavaanify](#) and [TAM::lavaanify.IRT](#)

## Examples

```
## Not run:
#####
# EXAMPLE 1: Path model data.bifie01
#####

data(data.bifie01)
dat <- data.bifie01
# create dataset with replicate weights and plausible values
bifieobj <- BIFIEsurvey::BIFIE.data.jack( data=dat, jktype="JK_TIMSS",
                                         jkzone="JKZONE", jkrep="JKREP", wgt="TOTWGT",
                                         pv_vars=c("ASMMAT","ASSSCI") )

#####
*** Model 1: Path model
lavmodel1 <- "
  ASMMAT ~ ASBG07A + ASBG07B + ASBM03 + ASBM02A + ASBM02E
  # define latent variable with 2nd and 3rd item in reversed scoring
  ASBM03 =~ 1*ASBM03A + (-1)*ASBM03B + (-1)*ASBM03C + 1*ASBM03D
  ASBG07A ~ ASBM02E
  ASBG07A =~ .2*ASBG07A # measurement error variance of .20
  ASBM02E =~ .45*ASBM02E # measurement error variance of .45
  ASBM02E ~ ASBM02A + ASBM02B
"

#--- Model 1a: model calculated by gender
mod1a <- BIFIEsurvey::BIFIE.pathmodel( bifieobj, lavmodel1, group="female" )
summary(mod1a)

#--- Model 1b: Input of some known reliabilities
reliability <- c( "ASBM02B"=.6, "ASBM02A"=.8 )
mod1b <- BIFIEsurvey::BIFIE.pathmodel( bifieobj, lavmodel1, reliability=reliability)
summary(mod1b)

#####
*** Model 2: Linear regression with errors in predictors

# specify lavaan model
lavmodel2 <- "
  ASMMAT ~ ASBG07A + ASBG07B + ASBM03A
  ASBG07A =~ .2*ASBG07A
"

mod2 <- BIFIEsurvey::BIFIE.pathmodel( bifieobj, lavmodel2 )
summary(mod2)
```



```
## End(Not run)
```

---

```
BIFIE.twolevelreg      Two Level Regression
```

---

### Description

This function computes the hierarchical two level model with random intercepts and random slopes. The full maximum likelihood estimation is conducted by means of an EM algorithm (Raudenbush & Bryk, 2002).

### Usage

```
BIFIE.twolevelreg( BIFIEobj, dep, formula.fixed, formula.random, idcluster,
  wgtlevel2=NULL, wgtlevel1=NULL, group=NULL, group_values=NULL,
  recov_constraint=NULL, se=TRUE, globconv=1E-6, maxiter=1000 )
```

```
## S3 method for class 'BIFIE.twolevelreg'
summary(object,digits=4,...)
```

```
## S3 method for class 'BIFIE.twolevelreg'
coef(object,...)
```

```
## S3 method for class 'BIFIE.twolevelreg'
vcov(object,...)
```

### Arguments

BIFIEobj	Object of class BIFIEdata
dep	String for the dependent variable in the regression model
formula.fixed	An R formula for fixed effects
formula.random	An R formula for random effects
idcluster	Cluster identifier. The cluster identifiers must be sorted in the BIFIE.data object.
wgtlevel2	Name of Level 2 weight variable
wgtlevel1	Name of Level 1 weight variable. This is optional. If it is not provided, wgtlevel1 is calculated from the total weight and wgtlevel2.
group	Optional grouping variable
group_values	Optional vector of grouping values. This can be omitted and grouping values will be determined automatically.

recov_constraint	Matrix for constraints of random effects covariance matrix. The random effects are numbered according to the order in the specification in <code>formula.random</code> . The first column in <code>recov_constraint</code> contains the row index in the covariance matrix, the second column the column index and the third column the value to be fixed.
se	Optional logical indicating whether statistical inference based on replication should be employed. In case of <code>se=FALSE</code> , standard errors are computed as maximum likelihood estimates under the assumption of random sampling of level 2 clusters.
globconv	Convergence criterion for maximum parameter change
maxiter	Maximum number of iterations
object	Object of class <code>BIFIE.twolevelreg</code>
digits	Number of digits for rounding output
...	Further arguments to be passed

### Details

The implemented random slope model can be written as

$$y_{ij} = \mathbf{X}_{ij}\boldsymbol{\gamma} + \mathbf{Z}_{ij}\mathbf{u}_j + \varepsilon_{ij}$$

where  $y_{ij}$  is the dependent variable,  $\mathbf{X}_{ij}$  includes the fixed effects predictors (specified by `formula.fixed`) and  $\mathbf{Z}_{ij}$  includes the random effects predictors (specified by `formula.random`). The random effects  $\mathbf{u}_j$  follow a multivariate normal distribution.

The function also computes a variance decomposition of explained variance due to fixed and random effects for the within and the between level. This variance decomposition is conducted for the predictor matrices  $\mathbf{X}$  and  $\mathbf{Z}$ . It is assumed that  $\mathbf{X}_{ij} = \mathbf{X}_j^B + \mathbf{X}_{ij}^W$ . The different sources of variance are computed by formulas as proposed in Snijders and Bosker (2012, Ch. 7).

### Value

A list with following entries

stat	Data frame with coefficients and different sources of variance.
output	Extensive output with all replicated statistics
...	More values

### References

- Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical linear models: Applications and data analysis methods*. Thousand Oaks: Sage.
- Snijders, T. A. B., & Bosker, R. J. (2012). *Multilevel analysis: An introduction to basic and advanced multilevel modeling*. Thousand Oaks: Sage.

## See Also

The `lme4::lmer` function in the **lme4** package allows only weights at the first level.

See the **WeMix** package (and the function `WeMix::mix`) for estimation of mixed effects models with weights at different levels.

## Examples

```
## Not run:
library(lme4)

#####
# EXAMPLE 1: Dataset data.bifie01 | TIMSS 2011
#####

data(data.bifie01)
dat <- data.bifie01
set.seed(987)

# create dataset with replicate weights and plausible values
bdat1 <- BIFIEsurvey::BIFIE.data.jack( data=dat, jktype="JK_TIMSS", jkzone="JKCZONE",
                                     jkrep="JKCREP", wgt="TOTWGT", pv_vars=c("ASMMAT", "ASSSCI") )

# create dataset without plausible values and ignoring weights
bdat2 <- BIFIEsurvey::BIFIE.data.jack( data=dat, jktype="JK_RANDOM", ngr=10 )
#=> standard errors from ML estimation

*****
# Model 1: Random intercept model

#--- Model 1a: without weights, first plausible value
mod1a <- BIFIEsurvey::BIFIE.twolevelreg( BIFIEobj=bdat2, dep="ASMMAT01",
                                       formula.fixed=~ 1, formula.random=~ 1, idcluster="idschool",
                                       wgtlevel2="one", se=FALSE )
summary(mod1a)

#--- Model 1b: estimation in lme4
mod1b <- lme4::lmer( ASMMAT01 ~ 1 + ( 1 | idschool), data=dat, REML=FALSE)
summary(mod1b)

#--- Model 1c: Like Model 1a but for five plausible values and ML inference
mod1c <- BIFIEsurvey::BIFIE.twolevelreg( BIFIEobj=bdat1, dep="ASMMAT",
                                       formula.fixed=~ 1, formula.random=~ 1, idcluster="idschool",
                                       wgtlevel2="one", se=FALSE )
summary(mod1c)

#--- Model 1d: weights and sampling design and all plausible values
mod1d <- BIFIEsurvey::BIFIE.twolevelreg( BIFIEobj=bdat1, dep="ASMMAT",
                                       formula.fixed=~ 1, formula.random=~ 1, idcluster="idschool",
                                       wgtlevel2="SCHWGT" )
summary(mod1d)

*****
```

```

# Model 2: Random slope model

#--- Model 2a: without weights
mod2a <- BIFIEsurvey::BIFIE.twolevelreg( BIFIEobj=bdat2, dep="ASMMAT01",
    formula.fixed=~ female + ASBG06A, formula.random=~ ASBG06A,
    idcluster="idschool", wgtlevel2="one", se=FALSE )
summary(mod2a)

#--- Model 2b: estimation in lme4
mod2b <- lme4::lmer( ASMMAT01 ~ female + ASBG06A + ( 1 + ASBG06A | idschool),
    data=dat, REML=FALSE)
summary(mod2b)

#--- Model 2c: weights and sampling design and all plausible values
mod2c <- BIFIEsurvey::BIFIE.twolevelreg( BIFIEobj=bdat1, dep="ASMMAT",
    formula.fixed=~ female + ASBG06A, formula.random=~ ASBG06A,
    idcluster="idschool", wgtlevel2="SCHWGT", maxiter=500, se=FALSE)
summary(mod2c)

#--- Model 2d: Uncorrelated intecepts and slopes

# constraint for zero covariance between intercept and slope
recov_constraint <- matrix( c(1,2,0), ncol=3 )
mod2d <- BIFIEsurvey::BIFIE.twolevelreg( BIFIEobj=bdat2, dep="ASMMAT01",
    formula.fixed=~ female + ASBG06A, formula.random=~ ASBG06A,
    idcluster="idschool", wgtlevel2="one", se=FALSE,
    recov_constraint=recov_constraint )
summary(mod2d)

#--- Model 2e: Fixed entries in the random effects covariance matrix

# two constraints for random effects covariance
# Cov(Int, Slo)=0 # zero slope for intercept and slope
# Var(Slo)=10 # slope variance of 10
recov_constraint <- matrix( c(1,2,0,
    2,2,10), ncol=3, byrow=TRUE)
mod2e <- BIFIEsurvey::BIFIE.twolevelreg( BIFIEobj=bdat2, dep="ASMMAT01",
    formula.fixed=~ female + ASBG06A, formula.random=~ ASBG06A,
    idcluster="idschool", wgtlevel2="one", se=FALSE,
    recov_constraint=recov_constraint )
summary(mod2e)

#####
# SIMULATED EXAMPLE 2: Two-level regression with random slopes
#####

#--- (1) simulate data
set.seed(9876)
NC <- 100 # number of clusters
Nj <- 20 # number of persons per cluster
iccx <- .4 # intra-class correlation predictor
theta <- c( 0.7, .3 ) # fixed effects
Tmat <- diag( c(.3, .1 ) ) # variances of random intercept and slope

```

```

sig2 <- .60 # residual variance
N <- NC*Nj
idcluster <- rep( 1:NC, each=Nj )
dat1 <- data.frame("idcluster"=idcluster )
dat1$X <- rep( stats::rnorm( NC, sd=sqrt(iccx) ), each=Nj ) +
           stats::rnorm( N, sd=sqrt( 1 - iccx) )
dat1$Y <- theta[1] + rep( stats::rnorm(NC, sd=sqrt(Tmat[1,1] ) ), each=Nj ) +
           theta[2] + rep( stats::rnorm(NC, sd=sqrt(Tmat[2,2])), each=Nj )) * dat1$X +
           stats::rnorm(N, sd=sqrt(sig2) )

#--- (2) create design object
bdat1 <- BIFIEsurvey::BIFIE.data.jack( data=dat1, jktype="JK_GROUP", jkzone="idcluster")
summary(bdat1)

#*** Model 1: Random slope model (ML standard errors)

#- estimation using BIFIE.twolevelreg
mod1a <- BIFIEsurvey::BIFIE.twolevelreg( BIFIEobj=bdat1, dep="Y",
                                       formula.fixed=~ 1+X, formula.random=~ 1+X, idcluster="idcluster",
                                       wgtlevel2="one", se=FALSE )
summary(mod1a)

#- estimation in lme4
mod1b <- lme4::lmer( Y ~ X + ( 1+X | idcluster), data=dat1, REML=FALSE )
summary(mod1b)

#- using Jackknife for inference
mod1c <- BIFIEsurvey::BIFIE.twolevelreg( BIFIEobj=bdat1, dep="Y",
                                       formula.fixed=~ 1+X, formula.random=~ 1+X, idcluster="idcluster",
                                       wgtlevel2="one", se=TRUE )
summary(mod1c)

# extract coefficients
coef(mod1a)
coef(mod1c)
# covariance matrix
vcov(mod1a)
vcov(mod1c)

## End(Not run)

```

## Description

Computes some univariate descriptive statistics (means and standard deviations).

**Usage**

```
BIFIE.univar(BIFIEobj, vars, group=NULL, group_values=NULL, se=TRUE)
```

```
## S3 method for class 'BIFIE.univar'
summary(object,digits=3,...)
```

```
## S3 method for class 'BIFIE.univar'
coef(object,...)
```

```
## S3 method for class 'BIFIE.univar'
vcov(object,...)
```

**Arguments**

BIFIEobj	Object of class BIFIEdata
vars	Vector of variables for which statistics should be computed
group	Optional grouping variable(s)
group_values	Optional vector of grouping values. This can be omitted and grouping values will be determined automatically.
se	Optional logical indicating whether statistical inference based on replication should be employed.
object	Object of class BIFIE.univar
digits	Number of digits for rounding output
...	Further arguments to be passed

**Value**

A list with following entries

stat	Data frame with univariate statistics
stat_M	Data frame with means
stat_SD	Data frame with standard deviations
output	Extensive output with all replicated statistics
...	More values

**See Also**

See [BIFIE.univar.test](#) for a test of equal means and effect sizes  $\eta$  and  $d$ .

Descriptive statistics without statistical inference can be estimated by the collection of [miceadds::ma.wtd.statNA](#) functions from the **miceadds** package.

Further descriptive functions:

[survey::svymean](#), [intsvy::timss.mean](#), [intsvy::timss.mean.pv](#), [stats::weighted.mean](#), [Hmisc::wtd.mean](#), [miceadds::ma.wtd.meanNA](#)

[survey::svyvar](#), [Hmisc::wtd.var](#), [miceadds::ma.wtd.sdNA](#), [miceadds::ma.wtd.covNA](#)

## Examples

```
#####
# EXAMPLE 1: Imputed TIMSS dataset
#####

data(data.timss1)
data(data.timssrep)

# create BIFIE.dat object
bdat <- BIFIEsurvey::BIFIE.data( data.list=data.timss1, wgt=data.timss1[[1]]$TOTWGT,
                               wgtrep=data.timssrep[, -1 ] )

# compute descriptives for plausible values
res1 <- BIFIEsurvey::BIFIE.univar( bdat, vars=c("ASMMAT", "ASSSCI", "books") )
summary(res1)

# split descriptives by number of books
res2 <- BIFIEsurvey::BIFIE.univar( bdat, vars=c("ASMMAT", "ASSSCI"), group="books",
                                   group_values=1:5)
summary(res2)

#####
# EXAMPLE 2: TIMSS dataset with missings
#####

data(data.timss2)
data(data.timssrep)

# use first dataset with missing data from data.timss2
bdat1 <- BIFIEsurvey::BIFIE.data( data.list=data.timss2[[1]], wgt=data.timss2[[1]]$TOTWGT,
                                 wgtrep=data.timssrep[, -1 ] )

# some descriptive statistics without statistical inference
res1a <- BIFIEsurvey::BIFIE.univar( bdat1, vars=c("ASMMAT", "ASSSCI", "books"), se=FALSE)
# descriptive statistics with statistical inference
res1b <- BIFIEsurvey::BIFIE.univar( bdat1, vars=c("ASMMAT", "ASSSCI", "books") )
summary(res1a)
summary(res1b)

# split descriptives by number of books
res2 <- BIFIEsurvey::BIFIE.univar( bdat1, vars=c("ASMMAT", "ASSSCI"), group="books")
# Note that if group_values is not specified as an argument it will be
# automatically determined by the observed frequencies in the dataset
summary(res2)
```

**Description**

Computes a Wald test which tests equality of means (univariate analysis of variance). In addition, the  $d$  and  $\eta$  effect sizes are computed.

**Usage**

```
BIFIE.univar.test(BIFIE.method, wald_test=TRUE)
```

```
## S3 method for class 'BIFIE.univar.test'
summary(object,digits=4,...)
```

**Arguments**

BIFIE.method	Object of class BIFIE.univar
wald_test	Optional logical indicating whether a Wald test should be performed.
object	Object of class BIFIE.univar.test
digits	Number of digits for rounding output
...	Further arguments to be passed

**Value**

A list with following entries

stat.F	Data frame with $F$ statistic for Wald test
stat.eta	Data frame with $\eta$ effect size and its inference
stat.dstat	Data frame with Cohen's $d$ effect size and its inference
...	More values

**See Also**

[BIFIE.univar](#)

**Examples**

```
#####
# EXAMPLE 1: Imputed TIMSS dataset - One grouping variable
#####

data(data.timss1)
data(data.timssrep)

# create BIFIE.dat object
bdat <- BIFIEsurvey::BIFIE.data( data.list=data.timss1, wgt=data.timss1[[1]]$TOTWGT,
                               wgtrep=data.timssrep[, -1 ] )

#**** Model 1: 3 variables splitted by book
res1 <- BIFIEsurvey::BIFIE.univar( bdat, vars=c("ASMMAT", "ASSSCI","scsci"),
                                  group="books")
```



```

summary(res1)
# analysis of variance
tres1 <- BIFIEsurvey::BIFIE.univar.test(res1)
summary(tres1)

##### Model 2: One variable splitted by gender
res2 <- BIFIEsurvey::BIFIE.univar( bdat, vars=c("ASMMAT"), group="female" )
summary(res2)
# analysis of variance
tres2 <- BIFIEsurvey::BIFIE.univar.test(res2)
summary(tres2)

## Not run:
##### Model 3: Univariate statistic: math
res3 <- BIFIEsurvey::BIFIE.univar( bdat, vars=c("ASMMAT") )
summary(res3)
tres3 <- BIFIEsurvey::BIFIE.univar.test(res3)

#####
# EXAMPLE 2: Imputed TIMSS dataset - Two grouping variables
#####

data(data.timss1)
data(data.timssrep)

# create BIFIE.dat object
bdat <- BIFIEsurvey::BIFIE.data( data.list=data.timss1, wgt=data.timss1[[1]]$TOTWGT,
                               wgtrep=data.timssrep[, -1 ] )

##### Model 1: 3 variables splitted by book and female
res1 <- BIFIEsurvey::BIFIE.univar(bdat, vars=c("ASMMAT", "ASSSCI", "scsci"),
                                group=c("books", "female"))
summary(res1)

# analysis of variance
tres1 <- BIFIEsurvey::BIFIE.univar.test(res1)
summary(tres1)

# extract data frame with Cohens d statistic
dstat <- tres1$stat.dstat

# extract d values for gender comparisons with same value of books
# -> 'books' refers to the first variable
ind <- which(
  unlist( lapply( strsplit( dstat$groupval1, "#"), FUN=function(vv){vv[1]} ) )==
  unlist( lapply( strsplit( dstat$groupval2, "#"), FUN=function(vv){vv[1]} ) )
)
dstat[ ind, ]

## End(Not run)

```

---

BIFIE.waldtest      *Wald Tests for BIFIE Methods*

---

### Description

This function performs a Wald test for objects of classes `BIFIE.by`, `BIFIE.correl`, `BIFIE.crosstab`, `BIFIE.freq`, `BIFIE.linreg`, `BIFIE.logistreg` and `BIFIE.univar`.

### Usage

```
BIFIE.waldtest(BIFIE.method, Cdes, rdes, type=NULL)
```

```
## S3 method for class 'BIFIE.waldtest'
summary(object,digits=4,...)
```

### Arguments

<code>BIFIE.method</code>	Object of classes <code>BIFIE.by</code> , <code>BIFIE.correl</code> , <code>BIFIE.crosstab</code> , <code>BIFIE.freq</code> , <code>BIFIE.linreg</code> , <code>BIFIE.logistreg</code> or <code>BIFIE.univar</code> (see parnames in the Output of these methods for saved parameters)
<code>Cdes</code>	Design matrix $C$ (see Details)
<code>rdes</code>	Design vector $r$ (see Details)
<code>type</code>	Only applies to <code>BIFIE.correl</code> . In case of <code>type="cov"</code> covariances instead of correlations are used for parameter tests.
<code>object</code>	Object of class <code>BIFIE.waldtest</code>
<code>digits</code>	Number of digits for rounding output
<code>...</code>	Further arguments to be passed

### Details

The Wald test is conducted for a parameter vector  $\theta$ , specifying the hypothesis  $C\theta = r$ . Statistical inference is performed by using the  $D_1$  and the  $D_2$  statistic (Enders, 2010, Ch. 8).

For objects of class `bifie.univar`, only hypotheses with respect to means are implemented.

### Value

A list with following entries

<code>stat.D</code>	Data frame with $D_1$ and $D_2$ statistic, degrees of freedom and p value
<code>...</code>	More values

### References

Enders, C. K. (2010). *Applied missing data analysis*. Guilford Press.

**See Also**

[survey::regTermTest](#), [survey::anova.svyglm](#), [car::linearHypothesis](#)

**Examples**

```
#####
# EXAMPLE 1: Imputed TIMSS dataset
#####

data(data.timss1)
data(data.timssrep)

# create BIFIE.dat object
bdat <- BIFIEsurvey::BIFIE.data( data.list=data.timss1, wgt=data.timss1[[1]]$TOTWGT,
                               wgtrep=data.timssrep[, -1 ] )

#####
#*** Model 1: Linear regression
res1 <- BIFIEsurvey::BIFIE.linreg( bdat, dep="ASMMAT", pre=c("one","books","migrant"),
                                group="female" )
summary(res1)

#*** Wald test which tests whether sigma and R^2 values are the same
res1$parnames # parameter names
pn <- res1$parnames ; PN <- length(pn)
Cdes <- matrix(0,nrow=2, ncol=PN)
colnames(Cdes) <- pn
# equality of R^2 ( R^2(female0) - R^2(female1)=0 )
Cdes[ 1, c("R^2_NA_female_0", "R^2_NA_female_1" ) ] <- c(1,-1)
# equality of sigma ( sigma(female0) - sigma(female1)=0)
Cdes[ 2, c("sigma_NA_female_0", "sigma_NA_female_1" ) ] <- c(1,-1)
# design vector
rdes <- rep(0,2)
# perform Wald test
wmod1 <- BIFIEsurvey::BIFIE.waldtest( BIFIE.method=res1, Cdes=Cdes, rdes=rdes )
summary(wmod1)

## Not run:
#####
#*** Model 2: Correlations

# compute some correlations
res2a <- BIFIEsurvey::BIFIE.correl( bdat, vars=c("ASMMAT","ASSSCI","migrant","books"))
summary(res2a)

# test whether r(MAT,migr)=r(SCI,migr) and r(MAT,books)=r(SCI,books)
pn <- res2a$parnames; PN <- length(pn)
Cdes <- matrix( 0, nrow=2, ncol=PN )
colnames(Cdes) <- pn
Cdes[ 1, c("ASMMAT_migrant", "ASSSCI_migrant") ] <- c(1,-1)
Cdes[ 2, c("ASMMAT_books", "ASSSCI_books") ] <- c(1,-1)
rdes <- rep(0,2)
```

```

# perform Wald test
wres2a <- BIFIEsurvey::BIFIE.waldtest( res2a, Cdes, rdes )
summary(wres2a)

#*****
#*** Model 3: Frequencies

# Number of books splitted by gender
res3a <- BIFIEsurvey::BIFIE.freq( bdat, vars=c("books"), group="female" )
summary(res3a)

# test whether book(cat4,female0)+book(cat5,female0)=book(cat4,female1)+book(cat5,female5)
pn <- res3a$parnames
PN <- length(pn)
Cdes <- matrix( 0, nrow=1, ncol=PN )
colnames(Cdes) <- pn
Cdes[ 1, c("books_4_female_0", "books_5_female_0",
          "books_4_female_1", "books_5_female_1" ) ] <- c(1,1,-1,-1)
rdes <- c(0)
# Wald test
wres3a <- BIFIEsurvey::BIFIE.waldtest( res3a, Cdes, rdes )
summary(wres3a)

#*****
#*** Model 4: Means

# math and science score splitted by gender
res4a <- BIFIEsurvey::BIFIE.univar( bdat, vars=c("ASMMAT","ASSSCI"), group="female")
summary(res4a)

# test whether there are significant gender differences in math and science
#=> multivariate ANOVA
pn <- res4a$parnames
PN <- length(pn)
Cdes <- matrix( 0, nrow=2, ncol=PN )
colnames(Cdes) <- pn
Cdes[ 1, c("ASMMAT_female_0", "ASMMAT_female_1" ) ] <- c(1,-1)
Cdes[ 2, c("ASSSCI_female_0", "ASSSCI_female_1" ) ] <- c(1,-1)
rdes <- rep(0,2)
# Wald test
wres4a <- BIFIEsurvey::BIFIE.waldtest( res4a, Cdes, rdes )
summary(wres4a)

## End(Not run)

```

**Description**

This function select variables and some (or all) imputed datasets of an object of class BIFIEdata and saves the resulting object also of class BIFIEdata.

**Usage**

```
BIFIEdata.select(bifieobj, varnames=NULL, impdata.index=NULL)
```

**Arguments**

bifieobj	Object of class BIFIEdata
varnames	Variables chosen for the selection
impdata.index	Selected indices of imputed datasets

**Value**

An object of class BIFIEdata saved in a non-compact or compact way, see value cdata

**See Also**

See [BIFIE.data](#) for creating BIFIEdata objects.

**Examples**

```
#####
# EXAMPLE 1: Some manipulations of BIFIEdata objects created from data.timss1
#####
data(data.timss1)
data(data.timssrep)

# create BIFIEdata
bdat1 <- BIFIEsurvey::BIFIE.data( data.list=data.timss1, wgt=data.timss1[[1]]$TOTWGT,
                                wgtrep=data.timssrep[, -1 ])
summary(bdat1)

# create BIFIEcdata object
bdat2 <- BIFIEsurvey::BIFIE.data( data.list=data.timss1, wgt=data.timss1[[1]]$TOTWGT,
                                wgtrep=data.timssrep[, -1 ], cdata=TRUE )
summary(bdat2)

# selection of variables for BIFIEdata object
bdat1a <- BIFIEsurvey::BIFIEdata.select( bdat1, varnames=bdat1$varnames[ 1:7 ] )
# selection of variables and 1st, 2nd and 4th imputed datasets of BIFIEcdata object
bdat2a <- BIFIEsurvey::BIFIEdata.select( bdat2, varnames=bdat2$varnames[ 1:7 ],
                                       impdata.index=c(1,2,4) )
summary(bdat1a)
summary(bdat2a)
```

---

BIFIEdata2svrepdesign *Conversion of a BIFIEdata Object into a svyrep Object in the **survey** Package*

---

### Description

Converts of a BIFIEdata object into a svyrep object in the **survey** package.

### Usage

```
BIFIEdata2svrepdesign(bifieobj)
```

### Arguments

bifieobj            Object of class BIFIEdata

### Value

Object of class svyrep.design or svyimputationList

### See Also

See the [BIFIE.data](#) function for creating objects of class BIFIEdata in **BIFIEsurvey**.

See the [survey::svrepdesign](#) function in the **survey** package.

### Examples

```
## Not run:
#####
# EXAMPLE 1: One dataset, TIMSS replication design
#####

data(data.timss3)
data(data.timssrep)

#--- create BIFIEdata object
bdat3 <- BIFIEsurvey::BIFIE.data.jack(data.timss3, jktype="JK_TIMSS")
summary(bdat3)

#--- create survey object directly in survey package
dat3a <- as.data.frame( cbind( data.timss3, data.timssrep ) )
RR <- ncol(data.timssrep) - 1        # number of jackknife zones
svydes3a <- survey::svrepdesign(data=dat3a, weights=~TOTWGT, type="JKn",
                                repweights='w_fstr[0-9]', scale=1, rcales=rep(1,RR), mse=TRUE )
print(svydes3a)

#--- create survey object by converting the BIFIEdata object to survey
svydes3b <- BIFIEsurvey::BIFIEdata2svrepdesign(bdat3)
```

```

*** compare results for the mean in Mathematics scores
mod1a <- BIFIEsurvey::BIFIE.univar( bdat3, vars="ASMMAT1")
mod1b <- survey::svymean( ~ ASMMAT1, design=svydes3a )
mod1c <- survey::svymean( ~ ASMMAT1, design=svydes3b )

#- coefficients
coef(mod1a); coef(mod1b); coef(mod1c)
#- standard errors
survey::SE(mod1a); survey::SE(mod1b); survey::SE(mod1c)

#####
# EXAMPLE 2: Multiply imputed datasets, TIMSS replication design
#####

data(data.timss2)
data(data.timssrep)

#--- create BIFIEdata object
bdat4 <- BIFIEsurvey::BIFIE.data( data=data.timss2, wgt="TOTWGT",
                                wgtrep=data.timssrep[,-1], fayfac=1)
print(bdat4)

#--- create object with imputed datasets in survey
datL <- mitools::imputationList( data.timss2 )
RR <- ncol(data.timssrep) - 1
weights <- data.timss2[[1]]$TOTWGT
repweights <- data.timssrep[,-1]
svydes4a <- survey::svrepdesign(data=datL, weights=weights, type="other",
                              repweights=repweights, scale=1, rscales=rep(1,RR), mse=TRUE)
print(svydes4a)

#--- create BIFIEdata object with conversion function
svydes4b <- BIFIEsurvey::BIFIEdata2svrepdesign(bdat4)

*** compare results for a mean
mod1a <- BIFIEsurvey::BIFIE.univar(bdat4, vars="ASMMAT")
mod1b <- mitools::MIcombine( with(svydes4a, survey::svymean( ~ ASMMAT, design=svydes4a )))
mod1c <- mitools::MIcombine( with(svydes4b, survey::svymean( ~ ASMMAT, design=svydes4b )))
# results
coef(mod1a); coef(mod1b); coef(mod1c)
survey::SE(mod1a); survey::SE(mod1b); survey::SE(mod1c)

## End(Not run)

```

---

BIFIEsurvey-utilities *Utility Functions in BIFIEsurvey*

---

## Description

Utility functions in **BIFIEsurvey**.

**Usage**

```
## Rubin rules
bifiesurvey_rcpp_rubin_rules(estimates, variances)
## Replication variance
bifiesurvey_rcpp_replication_variance(pars, pars_repl, fay_factor)
## Inference for nested multiple imputation
BIFIE_NMI_inference_parameters( parsM, parsrepM, fayfac, RR, Nimp, Nimp_NMI,
                               comp_cov=FALSE)
```

**Arguments**

estimates	Vector
variances	Vector
pars	Matrix
pars_repl	Matrix
fay_factor	Vector
parsM	Matrix
parsrepM	Matrix
fayfac	Vector
RR	Numeric
Nimp	Integer
Nimp_NMI	Integer
comp_cov	Logical

---

bifietable

*An Rcpp Based Version of the table Function*


---

**Description**

This is an **Rcpp** based version of the [base::table](#) function.

**Usage**

```
bifietable(vec, sort.names=FALSE)
```

**Arguments**

vec	A numeric or character vector
sort.names	An optional logical indicating whether values in the character vector should also be sorted in the table output

**Value**

Same output like [base::table](#)



**See Also**[base::table](#)**Examples**

```
data(data.timss1)
table( data.timss1[[1]][,"books"] )
BIFIEsurvey::bifietable( data.timss1[[1]][,"books"] )
```

---

`data.bifie`*Example Datasets for the **BIFIE**survey Package*

---

**Description**

Some example datasets.

**Usage**

```
data(data.bifie01)
```

**Format**

- The dataset `data.bifie01` contains data of 4th Grade Austrian students from the TIMSS 2011 study.

---

`data.pisaNLD`*Some PISA Datasets*

---

**Description**

Some PISA datasets.

**Usage**

```
data(data.pisaNLD)
```

**Format**

The dataset `data.pisaNLD` is a data frame with 3992 observations on 405 variables which is a part of the Dutch PISA 2006 data.

**Source**

Downloaded from <http://www.jstatsoft.org/v20/i05/>

## Examples

```
## Not run:
library(mitools)
library(survey)
library(intsvy)

#####
# EXAMPLE 1: Dutch PISA 2006 dataset
#####

data(data.pisaNLD)
data <- data.pisaNLD

#--- Create object of class BIFIEdata

# list variables with plausible values: These must be named
# as pv1math, pv2math, ..., pv5math, ...
pv_vars <- toupper( c("math", "math1", "math2", "math3", "math4",
                    "read", "scie", "prob") )
# create 5 datasets including different sets of plausible values
dfr <- NULL
VV <- length(pv_vars)
Nimp <- 5          # number of plausible values
for (vv in 1:VV){
  vv1 <- pv_vars[vv]
  ind.vv1 <- which( colnames(data) %in% paste0("PV", 1:Nimp, vv1) )
  dfr2 <- data.frame( "variable"=paste0("PV", vv1), "var_index"=vv,
                    "data_index"=ind.vv1, "impdata_index"=1:Nimp )
  dfr <- rbind( dfr, dfr2 )
}

sel_ind <- setdiff( 1:( ncol(data) ), dfr$data_index )
data0 <- data[, sel_ind ]
V0 <- ncol(data0)
newvars <- seq( V0+1, V0+VV )
datalist <- as.list( 1:Nimp )
for (ii in 1:Nimp ){
  dat1 <- data.frame( data0, data[, dfr[ dfr$impdata_index==ii, "data_index" ]])
  colnames(dat1)[ newvars ] <- paste0("PV",pv_vars)
  datalist[[ii]] <- dat1
}

# dataset with replicate weights
datarep <- data[, grep( "W_FSTR", colnames(data) ) ]
RR <- ncol(datarep)      # number of replicate weights

# create BIFIE object
bifieobj <- BIFIEsurvey::BIFIE.data( datalist, wgt=data[, "W_FSTUWT"],
                                   wgtrep=datarep, fayfac=1 / RR / ( 1 - .5 )^2 )
# For PISA: RR=80 and therefore fayfac=1/20=.05
summary(bifieobj)
```

```

#--- Create BIFIEdata object immediately using BIFIE.data.jack function
bifieobj1 <- BIFIEsurvey::BIFIE.data.jack( data.pisaNLD, jktype="RW_PISA", cdata=TRUE)
summary(bifieobj1)

#--- Create object in survey package
datL <- mitools::imputationList(list( datalist[[1]],datalist[[2]],
                                     datalist[[3]],datalist[[4]],datalist[[5]] ) )
pisades <- survey::svrepdesign(ids=~ 1, weights=~W_FSTUWT, data=datL,
                              repweights="W_FSTR[0-9]+", type="Fay", rho=0.5, mse=TRUE)
print(pisades)

#++++++ some comparisons with other packages ++++++

#**** Model 1: Means for mathematics and reading
# BIFIEsurvey package
mod1a <- BIFIEsurvey::BIFIE.univar( bifieobj, vars=c("PVMATH", "PVREAD") )
summary(mod1a)

# intsvy package
mod1b <- intsvy::pisa.mean.pv(pvlabel="MATH", data=data.pisaNLD )
mod1b

# survey package
mod1c <- with( pisades, survey::svymean(PVMATH~1, design=pisades) )
res1c <- mitools::MIcombine(mod1c)
summary(res1c)

#**** Model 2: Linear regression
# BIFIEsurvey package
mod2a <- BIFIEsurvey::BIFIE.linreg( bifieobj, dep="PVMATH",
                                   pre=c("one", "ANXMAT", "HISEI"))
summary(mod2a)

# intsvy package
mod2b <- intsvy::pisa.reg.pv(pvlabel="MATH", x=c("ANXMAT", "HISEI"), data=data.pisaNLD)
mod2b

# survey package
mod2c <- with( pisades, survey::svyglm(PVMATH~ANXMAT+HISEI, design=pisades) )
res2c <- mitools::MIcombine(mod2c)
summary(res2c)

## End(Not run)

```

---

data.test1

*Some Datasets for Testing Purposes*


---

### Description

Some datasets for testing purposes.

**Usage**

```
data(data.test1)
```

**Format**

The dataset `data.test1` is a dataset with a stratified clustered sample of 2101 students nested within 89 classes and 4 strata. The format is

```
'data.frame':  2101 obs. of  16 variables:
 $ idstud : num  10101 10102 10103 10104 10105 ...
 $ idclass: num  101 101 101 101 101 101 101 101 101 101 ...
 $ math   : num  108 107 101 91 157 ...
 $ engl   : num  95.2 133.3 94.9 97.6 142.3 ...
 $ germ   : num  125 150 107 113 139 ...
 $ stratum: num  1 1 1 1 1 1 1 1 1 1 ...
 $ female : int  1 1 1 1 0 0 0 0 0 0 ...
 $ age    : num  14.6 14.3 14.8 14.6 14.5 ...
 $ hisei  : int  43 43 43 67 51 30 30 51 68 70 ...
 $ paredu : int  2 2 1 4 5 2 1 5 7 7 ...
 $ books  : int  4 2 3 3 5 3 2 4 3 5 ...
 $ satisf : int  5 4 6 7 6 5 7 3 6 6 ...
 $ migrant: int  1 0 0 1 0 0 0 0 0 0 ...
 $ wgtstud: num  20.9 20.9 20.9 20.9 20.9 ...
 $ jkzone : num  101 101 101 101 101 101 101 101 101 101 ...
 $ jkrep  : num  0 0 0 0 0 0 0 0 0 0 ...
```

---

data.timss

*Dataset TIMSS 2011*

---

**Description**

Example dataset TIMSS 2011

**Usage**

```
data(data.timss1)
data(data.timss1.ind)
data(data.timss2)
data(data.timssrep)
data(data.timss3)
data(data.timss4)
```

## Format

The dataset `data.timss1` is a list containing 5 imputed datasets. The dataset `data.timss1.ind` contains response indicators of these 5 imputed datasets in `data.timss1`.

The dataset `data.timss2` is a list containing 5 datasets in which only plausible values are imputed, but student covariates are missing.

The dataset `data.timssrep` contains replicate weights of students.

The dataset `data.timss3` is a TIMSS dataset with some missing student covariates and all 5 plausible values contained in one file.

The dataset `data.timss4` is a list containing nested multiply imputed datasets, with 5 between-nest and 4 within-nest imputations.

## Examples

```
## Not run:
library(survey)
library(lavaan.survey)
library(intsvy)
library(mitools)

#####
# EXAMPLE 1: TIMSS dataset data.timss3 (one dataset including all PVs)
#####

data(data.timss2)
data(data.timss3)
data(data.timssrep)

# Analysis based on official 'single' datasets (data.timss3)
# There are 5 plausible values, but student covariates are not imputed.

#-- create object of class BIFIE data
bdat3 <- BIFIEsurvey::BIFIE.data(data.timss3, wgt=data.timss3$TOTWGT,
                                wgtrep=data.timssrep[,-1], fayfac=1)
summary(bdat3)
# This BIFIEdata object contains one dataset in which all
# plausible values are included. This object can be used
# in analysis without plausible values.
# Equivalently, one can define bdat3 much simpler by
bdat3 <- BIFIEsurvey::BIFIE.data.jack(data.timss3, jktype="JK_TIMSS")
summary(bdat3)

#-- In the following, the object bdat4 is defined with 5 datasets
# referring to 5 plausible values.
bdat4 <- BIFIEsurvey::BIFIE.data.jack(data.timss3, pv_vars=c("ASMMAT", "ASSSCI"),
                                      jktype="JK_TIMSS")
summary(bdat4)

#-- create object in survey package
dat3a <- as.data.frame( cbind( data.timss2[[1]], data.timssrep ) )
RR <- ncol(data.timssrep) - 1      # number of jackknife zones
```

```

svydes3 <- survey::svrepdesign(data=dat3a, weights=~TOTWGT, type="JKn",
                             repweights='w_fstr[0-9]', scale=1, rscales=rep(1,RR), mse=TRUE)
summary(svydes3)

#--- create object with imputed datasets in survey
datL <- data.timss2
# include replicate weights in each dataset
for (ii in 1:5){
  dat1 <- datL[[ii]]
  dat1 <- cbind( dat1, data.timssrep[, -1] )
  datL[[ii]] <- dat1
}
datL <- mitools::imputationList(list( datL[[1]], datL[[2]], datL[[3]], datL[[4]], datL[[5]]))
svydes4 <- survey::svrepdesign(data=datL, weights=~TOTWGT, type="JKn",
                             repweights='w_fstr[0-9]', scale=1, rscales=rep(1,RR), mse=TRUE)
summary(svydes4)

#--- reconstruct data.timss3 for intsvy package. Plausible values must be labeled
# as PV01, PV02, ... and NOT PV1, PV2, ...
data.timss3a <- data.timss3
colnames(data.timss3a) <- gsub( "ASMMAT", "ASMMAT0", colnames(data.timss3a) )
colnames(data.timss3a) <- gsub( "ASSSCI", "ASSSCI0", colnames(data.timss3a) )

#*****
# Model 1: Linear regression (no grouping variable)

#--- linear regression in survey
mod1a <- survey::svyglm( scsci ~ migrant + books, design=svydes3)
summary(mod1a)

#--- regression with pirls.reg (intsvy)
mod1b <- intsvy::pirls.reg( y="scsci", x=c("migrant", "books" ), data=data.timss3)
mod1b

#---- regression with BIFIEsurvey
mod1c <- BIFIEsurvey::BIFIE.linreg( bdat3, dep="scsci", pre=c("one", "migrant", "books"))
summary(mod1c)

#--- regression with lavaan.survey package
lavmodel <- "
  scsci ~ migrant + books
  scsci ~ 1
  scsci ~~ scsci
"
# fit in lavaan
lavaan.fit <- lavaan::lavaan( lavmodel, data=data.timss3, estimator="MLM")
summary(lavaan.fit)
# using all replicated weights
mod1d <- lavaan.survey::lavaan.survey(lavaan.fit=lavaan.fit, survey.design=svydes3 )
summary(mod1d)

#*****
# Model 2: Linear regression (grouped by female)

```

```

#--- linear regression in survey
mod2a <- survey::svyglm( scsci ~ 0 + as.factor(female) + as.factor(female):migrant
+ as.factor(female):books, design=svydes3)
summary(mod2a)

#--- regression with pirls.reg (intsvy)
mod2b <- intsvy::pirls.reg( y="scsci", x=c("migrant", "books" ),
by="female", data=data.timss3)
mod2b[["0"]] # regression coefficients female=0
mod2b[["1"]] # regression coefficients female=1

#--- regression with BIFIEsurvey
mod2c <- BIFIEsurvey::BIFIE.linreg( bdat3, dep="scsci",
pre=c("one","migrant","books"), group="female")
summary(mod2c)

#--- regression with lavaan.survey package
lavamodel <- "
scsci ~ migrant + books
scsci ~ 1
scsci ~~ scsci
"

# fit in lavaan
lavaan.fit <- lavaan::lavaan( lavamodel, data=data.timss3, group="female", estimator="MLM")
summary(lavaan.fit)
mod2d <- lavaan.survey::lavaan.survey(lavaan.fit=lavaan.fit, survey.design=svydes3 )
summary(mod2d)

#*****
# Model 3: Linear regression with mathematics PVs
library(mitools)

#--- linear regression in survey
mod3a <- with(svydes4, survey::svyglm( ASMMAT ~ migrant + books, design=svydes4 ) )
res3a <- mitools::MIcombine(mod3a)
summary(res3a)

#--- regression with pirls.reg.pv (intsvy)
mod3b <- intsvy::pirls.reg.pv( pvlabel="ASMMAT", x=c("migrant", "books" ),
data=data.timss3a)

#--- regression with BIFIEsurvey
mod3c <- BIFIEsurvey::BIFIE.linreg( bdat4, dep="ASMMAT", pre=c("one","migrant","books"))
summary(mod3c)

#--- regression with lavaan.survey package
lavamodel <- "
ASMMAT ~ migrant + books
ASMMAT ~ 1
ASMMAT ~~ ASMMAT
"

# fit in lavaan

```

```

lavaan.fit <- lavaan::lavaan( lavmodel, data=data.timss3a, group="female", estimator="MLM")
summary(lavaan.fit)
mod3d <- lavaan.survey::lavaan.survey(lavaan.fit=lavaan.fit, survey.design=svydes4 )
summary(mod3d)

#####
# EXAMPLE 2: TIMSS dataset data.timss4 | Nested multiply imputed dataset
#####

data(data.timss4)
data(data.timssrep)

**** create BIFIEdata object
bdat <- BIFIEsurvey::BIFIE.data( data.list=data.timss4, wgt=data.timss4[[1]][[1]]$TOTWGT,
                               wgtrep=data.timssrep[, -1 ], NMI=TRUE, cdata=TRUE )
summary(bdat)

**** Model 1: Linear regression for mathematics score
mod1 <- BIFIEsurvey::BIFIE.linreg( bdat, dep="ASMMAT", pre=c("one","books","migrant"))
summary(mod1)

*** Model 2: Univariate statistics ?BIFIEsurvey::BIFIE.univar
mod2 <- BIFIEsurvey::BIFIE.univar( bdat, vars=c("ASMMAT","ASSSCI","books") )
summary(mod2)

## End(Not run)

```

---

save.BIFIEdata

*Saving, Writing and Loading BIFIEdata Objects*


---

## Description

These functions save (save.BIFIEdata), write (write.BIFIEdata) or load (load.BIFIEdata) objects of class BIFIEdata.

The function load.BIFIEdata.files allows the creation of BIFIEdata objects by loading separate files of imputed datasets, replicate weights and a possible indicator dataset.

## Usage

```
save.BIFIEdata(BIFIEdata, name.BIFIEdata, cdata=TRUE, varnames=NULL)
```

```
write.BIFIEdata( BIFIEdata, name.BIFIEdata, dir=getwd(), varnames=NULL,
                impdata.index=NULL, type="Rdata", ... )
```

```
load.BIFIEdata(filename, dir=getwd() )
```

```
load.BIFIEdata.files( files.imp, wgt, file.wgtrep, file.ind=NULL,
                    type="Rdata",varnames=NULL, cdata=TRUE, dir=getwd(), ... )
```



**Arguments**

BIFIEdata	Object of class BIFIEdata
name.BIFIEdata	Name of BIFIEdata set to be saved
cdata	An optional logical indicating whether the dataset should be saved in a 'compact way'
varnames	Vector of variable names which should be saved. The default is to use all variables.
dir	Directory in which data files should be saved. The default is the working directory.
impdata.index	Vector of indices for selecting imputed datasets
type	Type of saved data. Options are Rdata (function <code>base::save</code> , <code>csv</code> (function <code>utils::write.csv</code> ), <code>csv2</code> (function <code>utils::write.csv2</code> ), <code>table</code> (function <code>utils::write.table</code> ), <code>sav</code> (function <code>foreign::read.spss</code> for reading sav files and function <code>sjlabelled::write_spss</code> for writing sav files).
...	Additional arguments to be passed to <code>base::save</code> , <code>utils::write.csv</code> , <code>utils::write.csv2</code> , <code>utils::write.table</code> , <code>foreign::read.spss</code> , <code>sjlabelled::write_spss</code>
filename	File name of BIFIEdata object
files.imp	Vector of file names of imputed datasets
wgt	Variable name of case weight
file.wgtrep	File name for dataset with replicate weights
file.ind	Optional. File name for dataset with response data indicators

**Value**

Saved R object and a summary in working directory or a loaded R object.

**See Also**

For creating objects of class BIFIEdata see [BIFIE.data](#).  
[base::save](#), [base::load](#)

**Examples**

```
## Not run:
#####
# EXAMPLE 1: Saving and loading BIFIE data objects
#####
data(data.timss1)
data(data.timssrep)

bifieobj <- BIFIEsurvey::BIFIE.data( data.list=data.timss1, wgt=data.timss1[[1]]$TOTWGT,
                                   wgtrep=data.timssrep[, -1 ] )
summary(bifieobj)

# save bifieobj in a compact way
BIFIEsurvey::save.BIFIEdata( BIFIEdata=bifieobj, name.BIFIEdata="timss1_cdata" )
```

```

# save bifieobj in a non-compact way
BIFIEsurvey::save.BIFIEdata( BIFIEdata=bifieobj, name.BIFIEdata="timss1_data", cdata=FALSE)

# load this object with object name "bdat2"
bdat2 <- BIFIEsurvey::load.BIFIEdata( filename="timss1_data.Rdata" )
summary(bdat2)

# save bifieobj with selected variables
BIFIEsurvey::save.BIFIEdata( bifieobj, name.BIFIEdata="timss1_selectvars_cdata",
                             varnames=bifieobj$varnames[ c(1:7,13,12,9) ] )
# the same object, but use the non-compact way of saving
BIFIEsurvey::save.BIFIEdata( bifieobj, name.BIFIEdata="timss1_selectvars_data", cdata=FALSE,
                             varnames=bifieobj$varnames[ c(1:7,13,12,9) ] )

# load object timss1_cdata (in compact data format)
bdat3 <- BIFIEsurvey::load.BIFIEdata( filename="timss1_cdata.Rdata" )
summary(bdat3)
# save selected variables of object bdat3
BIFIEsurvey::save.BIFIEdata( bdat3, name.BIFIEdata="timss1_selectvars2_cdata",
                             varnames=bifieobj$varnames[ c(1:4,12,8) ] )

#####
# EXAMPLE 2: Writing BIFIEdata objects
#####

data(data.timss2)
data(data.timssrep)

# create compactBIFIEdata
bifieobj <- BIFIEsurvey::BIFIE.data( data.list=data.timss2, wgt=data.timss2[[1]]$TOTWGT,
                                   wgtrep=data.timssrep[, -1 ], cdata=TRUE)
summary(bifieobj)

# save imputed datasets in format csv2
BIFIEsurvey::write.BIFIEdata( bifieobj, name.BIFIEdata="timss2_save1", type="csv2", row.names=FALSE)

# save imputed datasets of BIFIEdata object in format table without column names
# and code missings as "."
BIFIEsurvey::write.BIFIEdata( bifieobj, name.BIFIEdata="timss2_save2", type="table",
                              col.names=FALSE, row.names=FALSE, na="." )

# save imputed datasets of BIFIEdata object in format csv and select some variables
# and only the first three datasets
varnames <- c("IDSTUD","TOTWGT","female","books","lang","ASMMAT")
BIFIEsurvey::write.BIFIEdata( bifieobj, name.BIFIEdata="timss2_save3", type="csv",
                              impdata.index=1:3, varnames=varnames)

# save imputed datasets of BIFIEdata object in format Rdata, the R binary format
BIFIEsurvey::write.BIFIEdata( bifieobj, name.BIFIEdata="timss2_save4", type="Rdata" )

# save imputed datasets in sav (SPSS) format
BIFIEsurvey::write.BIFIEdata( bifieobj, name.BIFIEdata="timss2_save5", type="sav" )

```



```
summary(bifieobj)

#--- save datasets for the purpose of the following example
write.BIFIEdata( BIFIEdata=bifieobj, name.BIFIEdata="timss1_ex", type="Rdata" )
# save indicator dataset
save( data.timss1.ind, file="timss1_ex__IND.Rdata" )

# grep file names
files.imp <- miceadds::grep.vec( c("timss1_ex__IMP", ".Rdata" ),
                                list.files(getwd()) )$x
file.wgtrep <- miceadds::grep.vec( c("timss1_ex__WGTREP", ".Rdata" ),
                                  list.files(getwd()) )$x
file.ind <- miceadds::grep.vec( c("timss1_ex__IND", ".Rdata" ),
                                list.files(getwd()) )$x
# define variables for selection
varnames <- c("IDSTUD","TOTWGT","female","books","lang","ASMMAT")
# read files using indicator dataset
bifieobj2 <- BIFIEsurvey::load.BIFIEdata.files( files.imp, wgt="TOTWGT",
                                                file.wgtrep=file.wgtrep, file.ind=file.ind, type="Rdata",
                                                varnames=varnames)
summary(bifieobj2)

# read files without indicator dataset
bifieobj3 <- BIFIEsurvey::load.BIFIEdata.files( files.imp, wgt="TOTWGT",
                                                file.wgtrep=file.wgtrep, type="Rdata", varnames=varnames)
summary(bifieobj3)

# compare some descriptive statistics
res2 <- BIFIEsurvey::BIFIE.univar( bifieobj2, vars=c("books", "ASMMAT", "lang") )
res3 <- BIFIEsurvey::BIFIE.univar( bifieobj3, vars=c("books", "ASMMAT", "lang") )
summary(res2)
summary(res3)

## End(Not run)
```

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