

# Package ‘forsearch’

January 7, 2025

**Title** Diagnostic Analysis Using Forward Search Procedure for Various Models

**Version** 6.4.0

**Description** Identifies potential data outliers and their impact on estimates and analyses. Tool for evaluation of study credibility. Uses the forward search approach of Atkinson and Riani, ``Robust Diagnostic Regression Analysis'', 2000,<ISBN: o-387-95017-6> to prepare descriptive statistics of a dataset that is to be analyzed by functions `lm {stats}`, `glm {stats}`, `nls {stats}`, `lme {nlme}`, or `coxph {survival}`, or their equivalent in another language. Includes graphics functions to display the descriptive statistics.

**Depends** R ( $\geq 4.3.0$ )

**License** GPL ( $\geq 3$ )

**SystemRequirements** gmp ( $\geq 4.1$ )

**Encoding** UTF-8

**RoxygenNote** 7.3.2

**Imports** Hmisc( $\geq 5.2-1$ ), Cairo( $\geq 1.6-2$ ), formula.tools( $\geq 1.7.1$ ),  
ggplot2( $\geq 3.5.1$ ), nlme( $\geq 3.1-166$ ), rlang( $\geq 1.1.4$ ),  
survival( $\geq 3.3-3$ ), tibble( $\geq 3.2.1$ )

**Suggests** rmarkdown, knitr

**VignetteBuilder** knitr

**NeedsCompilation** no

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 forsearch-package

*Diagnostic Analysis Using Forward Search Procedure for Various Models*  
*Diagnostic Analysis Using Forward Search Procedure for Various Models*

---

## Description

Identifies potential data outliers and their impact on estimates and analyses. Tool for evaluation of study credibility. Uses the forward search approach of Atkinson and Riani, "Robust Diagnostic Regression Analysis", 2000, <ISBN: 0-387-95017-6> to prepare descriptive statistics of a dataset that is to be analyzed by functions `lm` {stats}, `glm` {stats}, `nls` {stats}, `lme` {nlme}, or `coxph` {survival}, or their equivalent in another language. Includes graphics functions to display the descriptive statistics.

## Details

The DESCRIPTION file:

```
Package:           forsearch
Title:            Diagnostic Analysis Using Forward Search Procedure for Various Models
Version:          6.4.0
Authors@R:       person("William", "Fairweather", email = "wrf343@flowervalleyconsulting.com", role = c("aut", "cre"))
Description:      Identifies potential data outliers and their impact on estimates and analyses. Tool for evaluation of study credibility.
Depends:          R (>= 4.3.0)
License:          GPL (>= 3)
LazyData:        TRUE
SystemRequirements: gmp (>= 4.1)
Encoding:         UTF-8
Roxygen:          list(markdown = TRUE)
RoxygenNote:     7.3.2
Imports:          Hmisc(>= 5.2-1), Cairo(>= 1.6-2), formula.tools(>= 1.7.1), ggplot2(>= 3.5.1), nlme(>= 3.1-166), rlang
Suggests:        rmarkdown, knitr
VignetteBuilder: knitr
Author:           William Fairweather [aut, cre]
Maintainer:      William Fairweather <wrf343@flowervalleyconsulting.com>
```

Index of help topics:

```
aStep1           Create Set of Observation Numbers in Step 1 for
                  Linear Model Analysis
aStep2           Update Observation Set in Step 2
bStep1           Create Set of Observation Numbers in Step 1 for
                  Linear Mixed Effects Model Analysis
bStep2           Update Observation Numbers in Step 2
cStep1           Create Set of Observation Numbers in Step 1 for
                  Cox Proportional Hazards Model Analysis
cStep2           Update Observation Set in Step 2
forsearch-package Diagnostic Analysis Using Forward Search
                  Procedure for Various Models Diagnostic
                  Analysis Using Forward Search Procedure for
                  Various Models
forsearch_cph    Create Statistics of Forward Search in a Cox
                  Proportional Hazard Database
```

forsearch_glm	Create Statistics of Forward Search in a Generalized Linear Model Database
forsearch_lm	Create Statistics Of Forward Search in a Linear Model Database
forsearch_lme	Create Statistics Of Forward Search For a Linear Mixed Effects Database
forsearch_nls	Create Statistics Of Forward Search in a Nonlinear Model Database
identifyCoeffs	Index To Identify Fixed and Random Coefficients To Appear Together on Plot
identifyFixedCoeffs	Index To Identify Fixed Coefficients To Appear Together on Plot
logist3	Three Parameter Logistic
plotdiag.AICX	Plot Diagnostic AIC Statistics
plotdiag.ANOX2	Plot Diagnostic Statistics of Analysis of Variance Tables
plotdiag.Cook	Plot Diagnostic Statistics of Modified Cook's Distance
plotdiag.Wald	Plot Diagnostic Statistics of Wald Test Output of COXPH Function
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plotdiag.blind.fixed	Plot Diagnostic Statistics of Fixed Coefficients for Blinded Dataset
plotdiag.deviance.residuals	Plot Diagnostic Statistics Of Deviance Residuals
plotdiag.deviences	Plot Diagnostic Deviance Statistics
plotdiag.fit3	Plot Diagnostic Statistics of AIC, BIC, and Log Likelihood
plotdiag.leverage	Plot Diagnostic Statistics Of Leverage
plotdiag.loglik	Plot Diagnostic Statistics of LOGLIK Output of COXPH Function
plotdiag.lrt	Plot Diagnostic Statistics of Likelihood Ratio Test of COXPH Function
plotdiag.params.fixed	Plot Diagnostic Statistics of Fixed Coefficients
plotdiag.params.random	Plot Diagnostic Statistics Of Random Coefficients
plotdiag.phihatx	Plot Diagnostic PhiHat Statistics
plotdiag.residuals	Plot Diagnostic Statistics Of Residuals Or Squared Residuals
plotdiag.s2	Plot Diagnostic Statistics Of Residual Variation
plotdiag.tstats	Plot Diagnostic T Statistics
search.history	Create Tabular History Of Forward Search
showme	Display Abbreviated Output of FORSEARCH_XXX

	Function
variablelist	Identify Level(s) to Which Each Factor Observation Belongs

Ensure that data frame has a leading column of observation numbers. Run `forsearch_foo` to create a file of diagnostic statistics to be used as input to such plotting functions as `plotdiag.residuals`, `plotdiag.params.fixed`, `plotdiag.params.random`, `plotdiag.s2`, `plotdiag.leverage`, and `plotdiag.Cook`. The file of diagnostic statistics can be voluminous, and the utility function `showme` displays the output more succinctly. Plotting of statistics for fixed and for random coefficients is limited by graphical restraints in some cases. The function `identifyCoeffs` provides a set of indexing codes so that `plotdiag.params.random` can display diagnostics for selected fixed or random model parameters. The function `identifyFixedCoeffs` does the same for lm models.

### Author(s)

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### References

Atkinson, A and M Riani. Robust Diagnostic Regression Analysis, Springer, New York, 2000.  
Pinheiro, JC and DM Bates. Mixed-Effects Models in S and S-Plus, Springer, New York, 2000.

---

aStep1	<i>Create Set of Observation Numbers in Step 1 for Linear Model Analysis</i>
--------	--

---

### Description

Derives the first set of observation numbers for `forsearch` in linear models

### Usage

```
aStep1(yesfactor, df1, df1.ls, inner.rank, initial.sample, formulaA,
       nofactform, ycol, b.d)
```

### Arguments

<code>yesfactor</code>	Logical. TRUE if there are factors in the X matrix
<code>df1</code>	Data frame being analyzed by forward search.
<code>df1.ls</code>	List, each element of which is a factor subset of <code>df1</code>
<code>inner.rank</code>	Rank of X matrix of lm analysis on entire database
<code>initial.sample</code>	Number of random samples from which to take set of initial observations
<code>formulaA</code>	Fixed parameter formula of lm function

nofactform	2-sided formula excluding factor variables
ycol	Response column number
b.d	Index of point to begin diagnostic listings

**Details**

Support function, usually not called independently

**Value**

Produces set of observation numbers for Step 1. Accounts for presence of factors in the dataset

**Note**

Presence of Observation column has no effect on outcome

**Author(s)**

William R. Fairweather

---

aStep2                      *Update Observation Set in Step 2*

---

**Description**

Derives the set of observation numbers for forsearch in Step 2 for linear models

**Usage**

```
aStep2(yesfactor, form.A2, finalm, rims, onlyfactor = FALSE, dfa2, finalm.ls,
       ycol,mstart, rnk, b.d)
```

**Arguments**

yesfactor	True or False for presence of factors
form.A2	Formula for analysis of entire dataset
finalm	See VALUE above. finalm argument is the same but only for Step 1 values
rims	List, each element is a matrix of obs numbers and corresponding subset codes
onlyfactor	Logical. TRUE if there are no continuous independent variables in the model
dfa2	Data frame being analyzed by forward search. Presence of Observation column has no effect on output
finalm.ls	List showing finalm separated into factor subsets
ycol	Response column number, including 1 for Observation
mstart	Number of first subset to be defined in Step 2
rnk	Rank of X matrix. For factors, this is rank with factors removed.
b.d	Number at which to begin diagnostic listings

**Details**

Support function, usually not called independently

**Value**

Vector of integers corresponding to observation numbers

**Author(s)**

William R. Fairweather

---

bStep1	<i>Create Set of Observation Numbers in Step 1 for Linear Mixed Effects Model Analysis</i>
--------	--

---

**Description**

Derives the first set of observation numbers for forsearch in linear mixed effects models

**Usage**

```
bStep1(yesfactor, df1, df1.ls, groups, inner.rank, source, initial.sample,
       nofactform = NULL, formulaA, randform, inc, ycol, b.d)
```

**Arguments**

yesfactor	Logical. TRUE if there are factors in the X matrix
df1	Data frame being analyzed by forward search.
df1.ls	List, each element of which is a factor subset of df1
groups	Vector of Quoted names of group variables
inner.rank	Rank of X matrix of lme analysis on entire database
source	Vector list of subsets provding observations
initial.sample	Number of random samples from which to take set of initial observations
nofactform	2-sided formula without factors
formulaA	Formula for all effects including factors and constructed variables
randform	One-sided random effects formula
inc	Logical. TRUE causes relaxation of lmeControl
ycol	Response column number
b.d	Index of point to begin diagnostic listings

**Details**

Support function, usually not called independently

**Value**

Produces set of observation numbers for Step 1. Accounts for presence of factors and groups in the dataset

**Note**

Presence of Observation column has no effect on outcome

**Author(s)**

William R. Fairweather

---

bStep2	<i>Update Observation Numbers in Step 2</i>
--------	---

---

**Description**

Derives the set of Step 2 observation numbers for forsearch in linear mixed effects models

**Usage**

```
bStep2(yf, f2, dfa2, randm2, onlyfactor = FALSE, ms, ycol, initn, inc, finalm, fbg, b.d)
```

**Arguments**

yf	Logical. Indicates presence of factor variables
f2	Fixed parameter formula
dfa2	Complete data set with factor subset identification codes
randm2	Random parameter formula
onlyfactor	TRUE if there are no continuous independent variables in the model
ms	Number of observations beginning Step 2
ycol	Column number of response variable
initn	Vector of number of observations from each group or fixed factor subset to draw for primary stage of step 2
inc	Logical. TRUE causes relaxation of lmeControl
finalm	List of expanding subset observation numbers
fbg	List of observation numbers by factor subgroup
b.d	Indicator of place in code to begin diagnostic printouts

**Details**

Support function, usually not called independently



**Value**

List of expanding number sets corresponding to observation numbers

**Author(s)**

William R. Fairweather

---

cStep1 *Create Set of Observation Numbers in Step 1 for Cox Proportional Hazards Model Analysis*

---

**Description**

Derives the first set of observation numbers for forward search in Cox Proportional Hazards models

**Usage**

```
cStep1(df1, df1.ls, inner.rank, initial.sample, f.e, cph ties, ycol, b.d)
```

**Arguments**

df1	Data frame being analyzed by forward search.
df1.ls	List, each element of which is a factor subset of df1
inner.rank	Rank of X matrix of lm analysis on entire database
initial.sample	Number of random samples from which to take set of initial observations
f.e	Right-hand side of formula for Surv function
cph ties	Character value of method of handling ties
ycol	Response column number
b.d	Index of point to begin diagnostic listings

**Details**

Support function, usually not called independently

**Value**

Produces set of observation numbers for Step 1. Accounts for presence of factors in the dataset

**Author(s)**

William R. Fairweather

---

cStep2

*Update Observation Set in Step 2*


---

**Description**

Derives the set of observation numbers for step 2 for forsearch in Cox proportional hazard models

**Usage**

```
cStep2(fe, finalm, rims, dfa2, onlyfactor=FALSE, ycol, cphties, mstart, rnk, b.d)
```

**Arguments**

fe	Right hand side of formula
finalm	List of rows in model at each stage
rims	List, each element is a complete matrix of obs numbers and corresponding subset codes
dfa2	Complete data frame with factor subset indicator codes
onlyfactor	Logical. TRUE if there are no continuous independent variables
ycol	Response column number
cphties	Character designation of method of handling ties
mstart	Number of observations in first stage of Step 2
rnk	Rank of linear analysis with factor variables removed
b.d	Indicator of starting point for diagnostic listings

**Details**

Support function; usually not called independently

**Value**

Vector of expanding number sets corresponding to observation numbers

**Author(s)**

William R. Fairweather

---

forsearch_cph	<i>Create Statistics of Forward Search in a Cox Proportional Hazard Database</i>
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---

**Description**

Prepares summary statistics at each stage of forward search for subsequent plotting.

**Usage**

```
forsearch_cph(alldata, formula.rhs, nofactform, initial.sample=1000,
              skip.step1=NULL, ties = "efron", maxdisturb=.01, proportion=TRUE,
              unblinded=TRUE, begin.diagnose= 100, verbose=TRUE)
```

**Arguments**

alldata	Data frame whose first 3 columns are Observation, event.time, and status, and whose last columns are independent variables. Factor variables must be defined in advance.
formula.rhs	The right hand side of a formula object (omit tilde '~')
nofactform	Formula, omitting all factor variables
initial.sample	Number of observations in Step 1 of forward search
skip.step1	NULL or a vector of integers for observations to be included in Step 1
ties	Method for handling ties in event time, "efron", "breslow" or "exact"; see survival::coxph
maxdisturb	Amount of maximum disturbance to add to each event time to prevent ties
proportion	Logical. TRUE causes running of survival::cox.zph on each stage
unblinded	TRUE causes printing of presumed analysis structure
begin.diagnose	Numeric. Indicates where in code to begin printing diagnostics. 0 prints all; 100 prints none
verbose	TRUE causes function identifier to display before and after run

**Details**

Step 1 requires one additional observation to be included in database to prevent failure of Wald statistic in Step 2 calculation of coxph function

**Value**

LIST

Rows in stage	Observation numbers of rows included at each stage
Number of model parameters	Number of fixed coefficients in Cox model

Fixed parameter estimates	Vector of parameter estimates at each stage
Wald Test	Vector of Wald tests at each stage
LogLikelihood	Vector of null and overall coefficients log likelihoods at each stage
Likelihood ratio test	Vector of LRTs at each stage
Leverage	Matrix of leverage of each observation at each stage
Call	Call to this function

**Author(s)**

William R. Fairweather

**References**

Atkinson, A and M Riani. Robust Diagnostic Regression Analysis, Springer, New York, 2000.

**Examples**

```

Observation <- 1:60
xx1 <- runif(60)
xx2 <- runif(60)
treat <- c(rep("A",30),rep("B",20),rep("C",10))
treat <- as.factor(treat)
event.time <- trunc(100*runif(60))
statusx <- c(rep(1,22),rep(0,8),rep(1,17),rep(0,3),rep(1,6),rep(0,4))
index3 <- sample(1:60,60)
xindep <- data.frame(Observation,event.time,status=statusx,xx1,xx2,treat)
formula.rhs <- "xx1 + xx2 + treat"
coxph.out05 <- forsearch_cph(alldata=xindep, formula.rhs=formula.rhs,
  nofactform="xx1 + xx2", skip.step1=NULL, ties="efron", initial.sample=500,
  begin.diagnose=100)

```

---

forsearch\_glm

*Create Statistics of Forward Search in a Generalized Linear Model Database*

---

**Description**

Prepares summary statistics at each stage of forward search for subsequent plotting. Forward search is conducted in three steps: Step 1 to identify minimal set of observations to estimate unknown parameters, and Step 2 to add one observation at each stage such that observations in the set are best fitting at that stage. A preliminary step (Step 0) contains code for pre-processing of the data.

**Usage**

```
forsearch_glm(initial.sample=1000, response.cols, indep.cols, family,
  formula=NULL, binomialrhs=NULL, formula.cont.rhs, data,
  estimate.phi = TRUE, wiggle=1, skip.step1=NULL, unblinded=TRUE,
  begin.diagnose=100, verbose=TRUE)
```

**Arguments**

<code>initial.sample</code>	Number of random sets of observations in Step 1 of forward search
<code>response.cols</code>	Vector of column numbers (1 or 2) of responses and nonresponses (if binomial)
<code>indep.cols</code>	Column number(s) of independent variables
<code>family</code>	Error distribution and link
<code>formula</code>	Formula relating response to independent variables. Required except for family=binomial
<code>binomialrhs</code>	Quoted character.Right-hand side of formula. Required for family=binomial
<code>formula.cont.rhs</code>	Quoted character.Right-hand side of formula, omitting factor variables. Required for all families
<code>data</code>	Name of database
<code>estimate.phi</code>	TRUE causes phi to be estimated; FALSE causes phi to be set = 1
<code>wiggle</code>	Number multiplier to minimize arbitrary exchange of observations in step 2. Default is 1. Used only if independent variables are all factors.
<code>skip.step1</code>	NULL, or vector of observation numbers to include at end of Step 1
<code>unblinded</code>	TRUE allows print of formula of analysis function
<code>begin.diagnose</code>	Numeric. Indicates where in code to begin printing diagnostics. 0 prints all; 100 prints none
<code>verbose</code>	TRUE causes function identifier to display before and after run

**Details**

Step 2 is determined by the results of Step 1, which itself is random. So, it is possible to reproduce the entire run by using the `skip.step1` argument. Inner subgroups are produced by presence of categorical variables. Current version assumes independent variables are all continuous.

**Value**

LIST

Rows in stage	Observation numbers of rows included at each stage
Family	Family and link
Number of model parameters	Number of fixed effect parameters
Fixed parameter estimates	Matrix of parameter estimates at each stage

Residual deviance	Vector of deviances
Null deviance	Vector of null deviances
PhiHat	Vector of values of phi parameter
Deviance residuals and augments	Deviance residuals with indication of whether each is included in fit
AIC	Vector of AIC values
Leverage	Matrix of leverage of each observation at each stage
Call	Call to this function

**Author(s)**

William R. Fairweather

**References**

Atkinson, A and M Riani. Robust Diagnostic Regression Analysis, Springer, New York, 2000.

**Examples**

```
## Not run:
# Train deaths (Atkinson and Riani, 2000) with Rolling Stock as a factor
Observation<-1:67
Month<-c(9,8,3,1,10,6,7,1,8,4,3,3,12,11,10,9,9,4,3,12,12,10,7,2,12,2,12,12,12,
  11,3,10,4,2,12,12,9,11,1,10,8,6,1,10,6,12,8,4,9,6,12,10,7,2,5,12,5,5,4,3,1,
  9,11,9,7,3,2)
Year<-c(97,96,96,95,94,94,91,91,90,89,89,89,88,88,87,86,86,86,86,84,84,84,84,84,
  83,83,82,81,81,80,80,79,79,79,78,78,77,76,76,75,75,75,75,74,74,73,73,73,72,
  72,71,71,71,71,70,69,69,69,69,69,69,68,67,67,67,67,67)
RollingStock<-c(2,2,3,2,1,1,1,1,2,3,1,1,1,2,1,2,1,3,2,2,1,2,2,3,1,2,1,1,2,3,1,
  1,1,1,1,1,1,3,3,2,3,1,2,3,1,1,1,3,3,1,3,3,1,1,1,2,1,1,2,1,1,1,1,1,1)
RollingStock <- as.factor(RollingStock)
Traffic<-c(0.436,0.424,0.424,0.426,0.419,0.419,0.439,0.439,0.431,0.436,0.436,
  0.436,0.443,0.443,0.397,0.414,0.414,0.414,0.414,0.389,0.389,0.389,0.389,
  0.389,0.401,0.401,0.372,0.417,0.417,0.43,0.43,0.426,0.426,0.426,0.43,0.43,
  0.425,0.426,0.426,0.436,0.436,0.436,0.436,0.452,0.452,0.433,0.433,0.433,
  0.431,0.431,0.444,0.444,0.444,0.444,0.452,0.447,0.447,0.447,0.447,0.447,
  0.447,0.449,0.459,0.459,0.459,0.459,0.459)
Deaths<-c(7,1,1,1,5,2,4,2,1,1,2,5,35,1,4,1,2,1,1,3,1,3,13,2,1,1,1,4,1,2,1,5,7,
  1,1,3,2,1,2,1,2,6,1,1,1,10,5,1,1,6,3,1,2,1,2,1,1,6,2,2,4,2,49,1,7,5,9)
train2022 <- data.frame(Observation, Year, RollingStock, Traffic, Deaths)
test02<-forsearch_glm(initial.sample = 100, response.cols = 5,
  indep.cols = 2:4, formula=Deaths~Year + RollingStock + Traffic,
  formula.cont.rhs="Year + Traffic",
  family = poisson("log"), data = train2022,
  estimate.phi = TRUE, skip.step1 = NULL,
  unblinded = TRUE, begin.diagnose=100)

## End(Not run)
```

forsearch\_lm

*Create Statistics Of Forward Search in a Linear Model Database***Description**

Prepares summary statistics at each stage of forward search for subsequent plotting. Forward search is conducted in two steps: Step 1 to identify minimal set of observations to estimate unknown parameters, and Step 2 to add one observation at each stage such that observations in the set are best fitting at that stage.

**Usage**

```
forsearch_lm(formula, nofactform, data, initial.sample=1000,
             skip.step1 = NULL, unblinded = TRUE, begin.diagnose = 100,
             verbose = TRUE)
```

**Arguments**

formula	Fixed effects formula as described in help(lm). The only permitted operators are +, :, and *. Terms must be found in data or as constructed by I(xxx) where xxx is found in data
nofactform	2-sided formula omitting all factors
data	Name of database
initial.sample	Number of observations in Step 1 of forward search
skip.step1	NULL or a vector of integers for observations to be included in Step 1
unblinded	TRUE causes printing of presumed analysis structure
begin.diagnose	Numeric. Indicates where in code to begin printing diagnostics. 0 prints all; 100 prints none
verbose	TRUE causes function identifier to display before and after run

**Value**

LIST

Rows in stage    Observation numbers of rows included at each stage

Standardized residuals

Matrix of errors at each stage

Number of model parameters

Rank of model

Sigma            Estimate of random error at final stage; used to standardize all residuals

Fixed parameter estimates

Vector of parameter estimates at each stage

s^2              Estimate of random error at each stage

Leverage        Matrix of leverage of each observation at each stage

Modified Cook distance  
 Estimate of sum of squared changes in parameter estimates at each stage

Call  
 Call to this function

**Author(s)**

William R. Fairweather

**References**

Atkinson, A and M Riani. Robust Diagnostic Regression Analysis, Springer, New York, 2000.

**Examples**

```
## Not run:
# Multiple regression
Observation <- 1:16
y <- runif(16)
x1 <- runif(16)
x2 <- runif(16)
x3 <- runif(16)
lmtest1 <- data.frame(Observation,y,x1,x2,x3)
test1 <- forsearch_lm(formula=y~x1+x2+x3, nofactform=y~x1+x2+x3, data=lmtest1,
  initial.sample=200,begin.diagnose=100)

# Analysis of variance
Observation <- 1:30
y <- runif(30)
AN1 <- as.factor(c(rep("A1",5),rep("A2",5),rep("A3",5)))
AN1 <- c(AN1,AN1)
AN2 <- as.factor(c(rep("B1",15),rep("B2",15)))
lmtest2 <- data.frame(Observation,y,AN1,AN2)
test2 <- forsearch_lm(formula=y~AN1*AN2, nofactform=y~1, data=lmtest2,
  initial.sample=200, begin.diagnose=100)

# Analysis of covariance
Observation <- 1:60
y <- runif(60)
AN1 <- as.factor(c(rep("A1",10),rep("A2",10),rep("A3",10)))
AN1 <- c(AN1,AN1)
AN2 <- as.factor(c(rep("B1",30),rep("B2",30)))
COV <- runif(60)
lmtest3 <- data.frame(Observation,y,AN1,AN2,COV)
test3 <- forsearch_lm(formula=y~AN1*AN2+COV, nofactform=y~COV, data=lmtest3,
  initial.sample=200,begin.diagnose=100)

# Polynomial regression
C1 <- 7*runif(60) + 1
y <- 4 + C1 - 6*C1^2 + 9*C1^3 + rnorm(60)
Observation <- 1:60
dfpoly <- data.frame(Observation,C1,y)
test4 <- forsearch_lm(formula = y ~ C1 + I(C1^2) + I(C1^3), data = dfpoly,
```



```

    nofactform=y ~ C1 + I(C1^2) + I(C1^3),initial.sample = 200,
    begin.diagnose=100)

## End(Not run)

```

---

forsearch\_lme                    *Create Statistics Of Forward Search For a Linear Mixed Effects Database*

---

## Description

Prepares summary statistics at each stage of forward search for subsequent plotting. Forward search is conducted in four steps: Step 0 to set up accounting for group structure, Step 1 to identify minimal set of observations to estimate unknown fixed parameters, Step 2 to identify the order of the remaining observations, and a final stage to extract the intermediate statistics based on increasing sample size.

## Usage

```

forsearch_lme(fixedform, nofactform, alldata, randomform, groupname, randfactnames=NULL,
  initial.sample=1000, skip.step1=NULL, unblinded=TRUE, begin.diagnose = 100,
  incCont=FALSE, verbose = TRUE)

```

## Arguments

fixedform	2-sided formula for fixed effects
nofactform	2-sided formula for fixed effects, omitting factors
alldata	data frame, first column of which must be "Observation"
randomform	1-sided formula for random effects
groupname	Quoted name of group variable in randomform. Nested grouping not permitted in this version
randfactnames	Vector of quoted names of random factor variables
initial.sample	Number of observations in Step 1 of forward search
skip.step1	NULL or a vector of integers for observations to be included in Step 1
unblinded	TRUE causes printing of presumed analysis structure
begin.diagnose	Numeric indicator of place in coding to begin printing diagnostic information. 0 prints all information, 100 prints none.
incCont	Logical. Currently ignored
verbose	TRUE causes function identifier to display before and after run

## Details

data will be grouped within the function, regardless of initial layout. Step 2 is determined by the results of Step 1, which itself is random. So, it is possible to reproduce the entire run by using the skip.step1 argument. Variables in the randomform formula must be character variables, but *\*not\** factors

**Value**

LIST	
Number of observations in Step 1	Number of observations included in Step 1
Step 1 observation numbers	Observation numbers useful in skipping step 1
Rows by outer subgroup	List of row numbers, by outer subgroup
Rows by outer-inner subgroups	List of row numbers, by outer-inner subgroup
Rows in stage	Observation numbers of rows included at each stage
Sigma	Estimate of random error at final stage; used to standardize all residuals
Standardized residuals	Matrix of errors at each stage
Fixed parameter estimates	Matrix of parameter estimates at each stage
Random parameter estimates	Matrix of parameter estimates at each stage
Leverage	Matrix of leverage of each observation at each stage
Modified Cook distance	Estimate of sum of squared changes in parameter estimates at each stage
Dims	Dims from fit of lme function
t statistics	t statistics for each fixed parameter
Fit statistics	AIC, BIC, and log likelihood
Call	Call to this function

**Author(s)**

William R. Fairweather

**References**

Atkinson, A and M Riani. Robust Diagnostic Regression Analysis, Springer, New York, 2000.  
 Pinheiro, JC and DM Bates. Mixed-Effects Models in S and S-Plus, Springer, New York, 2000.  
<https://CRAN.R-project.org/package=nlme>

**Examples**

```
## Not run:
# Multiple regression in grouped data
Observation <- 1:160
y <- runif(160)
x1 <- runif(160)
x2 <- runif(160)
x3 <- runif(160)
```

```

group <- rep(c("G1", "G2"), each=80)
lmetest1 <- data.frame(Observation, y, x1, x2, x3, group)
forsearch_lme(fixedform=y~x1+x2+x3, nofactform=y~x1+x2+x3, alldata=lmetest1,
  randomform= ~1|group, groupname="group", initial.sample=200)

# Analysis of variance in grouped data
Observation <- 1:60
y <- runif(60)
AN1 <- as.factor(c(rep("A1", 5), rep("A2", 5), rep("A3", 5)))
AN1 <- c(AN1, AN1, AN1, AN1)
AN2 <- as.factor(c(rep("B1", 15), rep("B2", 15)))
AN2 <- c(AN2, AN2)
group <- rep(c("G1", "G2"), each=30)
lmetest2 <- data.frame(Observation, y, AN1, AN2, group)
forsearch_lme(fixedform=y~AN1*AN2, nofactform=y~1, alldata=lmetest2,
  randomform= ~1|group, groupname="group", initial.sample=500)

# Analysis of covariance in grouped data

Observation <- 1:120
y <- runif(120)
AN1 <- as.factor(c(rep("A1", 10), rep("A2", 10), rep("A3", 10), rep("A4", 10)))
AN1 <- c(AN1, AN1, AN1)
AN2 <- as.factor(c(rep("B1", 5), rep("B2", 5)))
AN2 <- c(AN2, AN2, AN2, AN2, AN2, AN2)
AN2 <- c(AN2, AN2)
COV <- runif(120)
group <- rep(c("G1", "G2"), each=30)
group <- c(group, group)
lmetest3 <- data.frame(Observation, y, AN1, AN2, COV, group)
test3<-forsearch_lme(fixedform=y~AN1*AN2+COV, nofactform=y~COV, alldata=lmetest3,
  randomform= ~ 1 | group, groupname="group", initial.sample=500,
  begin.diagnose=100)

## End(Not run)

```

**Description**

Prepares summary statistics at each stage of forward search for subsequent plotting. Forward search is conducted in two steps: Step 1 to identify minimal set of observations to estimate unknown parameters, and Step 2 to add one observation at each stage such that observations in the set are best fitting at that stage.

**Usage**

```

forsearch_nls(nlsform, data, start, algorithm="default",
  nls.control=FALSE, initial.sample=1000, skip.step1=NULL, begin.diagnose=100,
  verbose=TRUE)

```

**Arguments**

nlsform	Formula for nls function
data	Name of database. First 2 variables are Observation and Section (both mandatory)
start	LIST of starting values for nls
algorithm	algorithm for nls function
nls.control	Logical. TRUE makes nls controls more liberal
initial.sample	Number of observation sets in Step 1 of forward search
skip.step1	NULL or a vector of integers for observations to be included in Step 1
begin.diagnose	Numeric. Indicates where in code to begin printing diagnostics. 0 prints all; 100 prints none
verbose	TRUE causes function identifier to display before and after run

**Value**

LIST	
Rows in stage	Observation numbers of rows included at each stage
Standardized residuals	Matrix of errors at each stage
Number of model parameters	Same as number of levels of start variable
Sigma	Estimate of random error at final stage; used to standardize all residuals
Fixed parameter estimates	Vector of parameter estimates at each stage
s <sup>2</sup>	Estimate of random error at each stage
Call	Call to this function

**Author(s)**

William R. Fairweather

**References**

Atkinson, A and M Riani. Robust Diagnostic Regression Analysis, Springer, New York, 2000.  
 Pinheiro, JC and DM Bates. Mixed Effects Models in S and S-PLUS, Springer, New York, 2000.  
<https://cran.r-project.org/web/packages/nlstools/vignettes/vignetteJSS.pdf>

**Examples**

```
## Not run:
Observation <- 1:70
Section <- rep(c(1,1,1,1,1,2,2,2,2), times=7)
Tree <- rep(1:7, each=10)
age <- rep(c(1,3,5,7,9,11,13,15,17,19), times = 7) * 100
circum <- forsearch::logist3(age, a=170, b=7, c=500) + rnorm(70)*0.1
```

```

test02 <- data.frame(Observation, Section, Tree, age, circum)
startPru <- list(Asym=170, xmid=7, scal=500)
formulaPru <- circum ~ I(logist3(x=age, a=Asym, b=xmid, c=scal))
forsearch_nls(nlsform = formulaPru,
              data=test02, start=startPru, nls.control=TRUE,
              initial.sample = 179, skip.step1=NULL, begin.diagnose=100, verbose=TRUE)

t <- (0:35)/3
V02<- c(377.1111, 333.3333, 352.1429, 328.7500, 369.8750 ,394.4000, 352.6667,
        337.3333, 366.4286, 364.0000, 293.8889, 387.0000, 364.8889, 342.2222,
        400.3000, 375.1111 ,320.5556, 385.1667)
V02<- c(V02,527.0714,688.6364,890.8182,1145.1538, 1254.9091, 1327.5000,1463.9000,
        1487.8333 ,1586.6667, 1619.1000, 1494.4167 ,1640.4545, 1643.3750,
        1583.6364, 1610.8000 ,1568.5000, 1464.5833, 1652.8000)
test01 <- data.frame(t,V02)
Observation <- 1:36
Section <- c(rep(1,20),rep(2,8),rep(3,8))
test01 <- cbind(Observation, Section, test01)
pstart <- list(V02rest=400, V02peak = 1600, mu = 1)
pformula <- as.formula(V02~(t<=5.883)*(V02rest)+
                      (t>5.883)*(V02rest+(V02peak-V02rest)*
                      (1-exp(-(t-5.883)*I(1/mu)))))
test2 <- forsearch_nls(nlsform=pformula, data = test01,
                      start=pstart, nls.control=FALSE, initial.sample = 300, skip.step1=NULL,
                      begin.diagnose=100, verbose=TRUE)

## End(Not run)

```

---

identifyCoeffs	<i>Index To Identify Fixed and Random Coefficients To Appear Together on Plot</i>
----------------	---

---

### Description

Runs the defined, grouped linear mixed effects (lme) model. Displays the resulting fixed and random coefficients. Attaches codes for identifying them to the plotting functions of this package.

### Usage

```

identifyCoeffs(fixed, data, random,
              XmaxIter = 1000, XmsMaxIter = 1000,
              Xtolerance = 0.01, XniterEM = 1000, XmsMaxEval = 400, XmsTol = 1e-05,
              Xopt = "optim", verbose = TRUE)

```

### Arguments

fixed	2-sided formula for fixed effects
data	Name of file (to be) run by forsearch_lme

random	1-sided formula for random effects
XmaxIter	lme control parameter
XmsMaxIter	lme control parameter
Xtolerance	lme control parameter
XniterEM	lme control parameter
XmsMaxEval	lme control parameter
XmsTol	lme control parameter
Xopt	lme control parameter
verbose	If TRUE, indicates beginning and end of function

### Details

Plotting functions cannot plot more than a few coefficients on one graph. This function prepares an index of the coefficients so that the user can more easily identify which ones should appear together in a plot.

### Value

Index of fixed and random coefficients from `forsearch_lme`.

### Author(s)

William R. Fairweather

### References

Atkinson, A and M Riani. Robust Diagnostic Regression Analysis, Springer, New York, 2000.

### Examples

```
info3 <- system.file("extdata", "Machines.0.R", package="forsearch");
info3 <- source(info3);
info3 <- info3[[1]];
identifyCoeffs(fixed=score~1, data=info3, random= ~1 | Worker)
```

---

identifyFixedCoeffs     *Index To Identify Fixed Coefficients To Appear Together on Plot*

---

### Description

Runs the defined linear (lm) model. Displays the resulting coefficients. Attaches codes for identifying them to the plotting functions of this package.

### Usage

```
identifyFixedCoeffs(formula, data, verbose = TRUE)
```

**Arguments**

formula	2-sided formula for fixed effects
data	Name of file (to be) run by forsearch_lm
verbose	If TRUE, indicates beginning and end of function

**Details**

Plotting functions cannot plot more than a few coefficients on one graph. This function prepares an index of the coefficients so that the user can more easily identify which ones should appear together in a plot.

**Value**

Index of coefficients from forsearch\_lm.

**Author(s)**

William R. Fairweather

**References**

Atkinson, A and M Riani. Robust Diagnostic Regression Analysis, Springer, New York, 2000.

**Examples**

```
info3 <- system.file("extdata", "crossdata.R", package="forsearch");
crossdata <- source(info3);
crossdata <- crossdata[[1]];
identifyFixedCoeffs(formula=y~x1*x2, data=crossdata)
```

---

logist3

*Three Parameter Logistic*

---

**Description**

Calculates three parameter logistic function

**Usage**

```
logist3(x, a, b, c)
```

**Arguments**

x	Independent variable
a	First parameter. See details
b	Second parameter
c	Third parameter

**Details**

Calculates  $y = a/(1 + xx)$ , where  $xx = \exp(-(x - b)/c)$

**Value**

Numerical output of the function described in details

**Author(s)**

William R. Fairweather

---

plotdiag.AICX

*Plot Diagnostic AIC Statistics*

---

**Description**

Plot output from `forsearch_glm` to show change in AIC statistics as the number of observations in the forward search procedure increases. Save plot in folder containing working directory.

**Usage**

```
plotdiag.AICX(forn, maintitle = "Put main title here",
  subtitle = "Put subtitle here", caption="Put caption title here",
  wmf = "Put_plot_file_title_here",
  Cairo=TRUE, printgraph=TRUE,addline="none",
  verbose = TRUE)
```

**Arguments**

<code>forn</code>	Name of output file from <code>forsearch_glm</code>
<code>maintitle</code>	Main title of plot
<code>subtitle</code>	Subtitle of plot
<code>caption</code>	Content of caption
<code>wmf</code>	File name of stored plot; omit ".wmf"
<code>Cairo</code>	TRUE causes use of Cairo graphics
<code>printgraph</code>	TRUE causes graph to print to file and closes device
<code>addline</code>	add a line to the graph; "none", "loess", or "straight"); abbreviation allowed
<code>verbose</code>	If TRUE, indicates beginning and end of function

**Value**

Process and plot AIC statistics from `forsearch_glm`

**Author(s)**

William R. Fairweather



**References**

Atkinson, A and M Riani. Robust Diagnostic Regression Analysis, Springer, New York, 2000.

---

plotdiag.allgraphs      *Execute All Plotting Functions For a Select Forsearch Object*

---

**Description**

Executes all the plotting functions for a select analytical function such as lm or glm; default omits titles and subtitles and attempts to plot all fixed and random coefficients.

**Usage**

```
plotdiag.allgraphs(object, mt=" ", st=" ", cpt=" ", blind.label=FALSE, cc=NULL,
                   ccrand = NULL,Cairo=TRUE)
```

**Arguments**

object	Name of forsearch object file
mt	Maintitle of graph
st	Subtitle of graph
cpt	Caption on the graph
blind.label	TRUE causes 'blind' to be added to graph and to file name for fixed parameters
cc	Fixed variable code numbers of coefficients to be included in graph
ccrand	Random variable code numbers of parameters to be included in graph
Cairo	TRUE causes use of Cairo graphics

**Value**

Prints search history and creates graphical files in current subdirectory

**Author(s)**

William R. Fairweather

---

plotdiag.ANOX2

*Plot Diagnostic Statistics of Analysis of Variance Tables*


---

**Description**

Plot output from forsearch\_XXX to show change in anova p-values as the number of observations in the forward search procedure increases. Save plot in folder containing working directory.

**Usage**

```
plotdiag.ANOX2(forn, anova.rows=NULL, ylab.extend=c("proportionality","variance"),
  maintitle = "Put main title here",
  subtitle = "Put subtitle here", caption="Put caption here", wmf = "Put_stored_name_here",
  Cairo=TRUE, printgraph=TRUE, legend = "Dummy legend name",
  verbose = TRUE)
```

**Arguments**

forn	Name of output file from forsearch_XXX
anova.rows	Row numbers of p values to include together on the plot
ylab.extend	Type of anova table. "proportionality" is a test of proportionality for a coxph analysis; "variance" is a test of null hypothesis of a lm or lme test
maintitle	Main title of plot
subtitle	Subtitle of plot
caption	Content of caption
wmf	File name of stored plot; omit ".wmf"
Cairo	TRUE causes use of Cairo graphics
printgraph	TRUE causes graph to print to file and closes device
legend	Name of legend
verbose	If TRUE, indicates beginning and end of function

**Value**

Process and plot anova test p values from forsearch\_lm or forsearch\_lme

**Author(s)**

William R. Fairweather

**References**

Atkinson, A and M Riani. Robust Diagnostic Regression Analysis, Springer, New York, 2000.

---

plotdiag.blind.fixed *Plot Diagnostic Statistics of Fixed Coefficients for Blinded Dataset*

---

### Description

Plot output from forsearch\_XXX to show change in fixed coefficients as the number of observations in the forward search procedure increases. Save plot in folder containing working directory. Run on blinded data only.

### Usage

```
plotdiag.blind.fixed(forn, coeff.codenums=NULL, maintitle = "Put main title here",
  subtitle = "Put subtitle here", caption="Put caption here", wmf = "Put_stored_name_here",
  Cairo=TRUE, printgraph=TRUE, legend = "Dummy legend name",
  verbose = TRUE)
```

### Arguments

forn	Name of output file from forsearch_XXX
coeff.codenums	Numeric vector of coefficients to include together on the plot. Codes are output by identifyFixedCoeffs (for lm files) or by identifyCoeffs function (for lme files)
maintitle	Main title of plot
subtitle	Subtitle of plot
caption	Content of caption
wmf	File name of stored plot; omit ".wmf"
Cairo	TRUE causes use of Cairo graphics
printgraph	TRUE causes graph to print to file and closes device
legend	Name of legend
verbose	If TRUE, indicates beginning and end of function

### Value

Process and plot fixed coefficient statistics from forsearch\_lm or forsearch\_lme

### Author(s)

William R. Fairweather

### References

Atkinson, A and M Riani. Robust Diagnostic Regression Analysis, Springer, New York, 2000.

---

plotdiag.Cook

*Plot Diagnostic Statistics of Modified Cook's Distance*


---

### Description

Plot output from `forsearch_lm` or `forsearch_lme` to show change in Modified Cook's distance as the number of observations in the forward search procedure increases. Save plot in folder containing working directory.

### Usage

```
plotdiag.Cook(forn, maintitle = "Put main title here", subtitle = "Put subtitle here",
caption = "Put caption here", wmf = "Put_plot_file_title_here",
Cairo=TRUE, printgraph=TRUE, addline = "none", verbose = TRUE)
```

### Arguments

<code>forn</code>	Name of forward search output file
<code>maintitle</code>	Main title of plot
<code>subtitle</code>	Subtitle of plot
<code>caption</code>	Content of caption
<code>wmf</code>	File name of stored plot; omit ".wmf"
<code>Cairo</code>	TRUE causes use of Cairo graphics
<code>printgraph</code>	TRUE causes graph to print to file and closes device
<code>addline</code>	Character variable to add a line to the graph; options: "none", "loess", and "straight"; abbreviation allowed
<code>verbose</code>	If TRUE, indicates beginning and end of function

### Value

Process and plot Cook distance statistics from `forsearch_lm` or `forsearch_lme`

### Author(s)

William R. Fairweather

### References

Atkinson, A and M Riani. Robust Diagnostic Regression Analysis, Springer, New York, 2000.

---

 plotdiag.deviance.residuals

*Plot Diagnostic Statistics Of Deviance Residuals*


---

## Description

Plot output from `forsearch_glm` to show change in deviance residuals or augmented deviance residuals, either of which can be squared, as the number of observations in the forward search procedure increases. Save plot in folder containing working directory.

## Usage

```
plotdiag.deviance.residuals(forn, squared = FALSE, augmented=TRUE, hilos = c(1, 0),
  maintitle="Put main title here", subtitle="Put subtitle here", caption="Put caption here",
  wmf= "Put_graph_title_here", Cairo=TRUE, printgraph=TRUE,
  legend = "Dummy legend name", verbose = TRUE)
```

## Arguments

<code>forn</code>	Name of forward search output file
<code>squared</code>	TRUE causes residuals to be squared before plotting
<code>augmented</code>	TRUE causes graphing of augmented deviance residuals, see Details
<code>hilos</code>	Number of observations having high and number having low values of residuals to identify. No low values are identified for squared residual plot
<code>maintitle</code>	Main title of plot
<code>subtitle</code>	Subtitle of plot
<code>caption</code>	Caption of plot
<code>wmf</code>	File name of stored plot; omit ".wmf"
<code>Cairo</code>	TRUE causes use of Cairo graphics
<code>printgraph</code>	TRUE causes graph to print to file and closes device
<code>legend</code>	Legend title
<code>verbose</code>	If TRUE, indicates beginning and end of function

## Details

We reserve the use of the term 'Deviance residuals' to deviance residuals of the observations that were used to create the model fit, and use the term 'Augmented deviance residuals' to refer to deviance residuals of all available observations. The latter are created by predicting the fit of the model to all observations.

## Value

Process and plot changes in deviance residuals or squared deviance residuals from `forsearch_glm`

**Author(s)**

William R. Fairweather

**References**

Atkinson, A and M Riani. Robust Diagnostic Regression Analysis, Springer, New York, 2000.

plotdiag.deviances      *Plot Diagnostic Deviance Statistics*

**Description**

Plot output from `forsearch_glm` to show change in deviances as the number of observations in the forward search procedure increases. Save plot in folder containing working directory.

**Usage**

```
plotdiag.deviances(forn, devtype, maintitle = "Put main title here",
  subtitle = "Put subtitle here", caption="Put caption here",
  wmf = "Put_plot_file_title_here",
  Cairo=TRUE, printgraph=TRUE,addline="none",
  verbose = TRUE)
```

**Arguments**

<code>forn</code>	Name of output file from <code>forsearch_glm</code>
<code>devtype</code>	Type of deviance: "R" or "N" for Residual deviance or Null deviance
<code>maintitle</code>	Main title of plot
<code>subtitle</code>	Subtitle of plot
<code>caption</code>	Content of caption
<code>wmf</code>	File name of stored plot; omit ".wmf"
<code>Cairo</code>	TRUE causes use of Cairo graphics
<code>printgraph</code>	TRUE causes graph to print to file and closes device
<code>addline</code>	add a line to the graph; abbreviation allowed; "none", "loess", or "straight"
<code>verbose</code>	If TRUE, indicates beginning and end of function

**Value**

Process and plot deviances from `forsearch_glm`

**Author(s)**

William R. Fairweather

**References**

Atkinson, A and M Riani. Robust Diagnostic Regression Analysis, Springer, New York, 2000.

**Description**

Plot output from `forsearch_lm` to show change in AIC, BIC, and log likelihood as the number of observations in the forward search procedure increases. Save plot in folder containing working directory.

**Usage**

```
plotdiag.fit3(forn, maintitle = "Put main title here", subtitle = "Put subtitle here",  
caption = "Put caption here", wmf = "Put_stored_name_here",  
Cairo=TRUE, printgraph=TRUE, legend="Dummy legend name",  
verbose = TRUE)
```

**Arguments**

<code>forn</code>	Name of output file from <code>forsearch_lm</code>
<code>maintitle</code>	Main title of plot
<code>subtitle</code>	Subtitle of plot
<code>caption</code>	Content of caption
<code>wmf</code>	File name of stored plot; omit ".wmf"
<code>Cairo</code>	TRUE causes use of Cairo graphics
<code>printgraph</code>	TRUE causes graph to print to file and closes device
<code>legend</code>	Legend name
<code>verbose</code>	If TRUE, indicates beginning and end of function

**Value**

Process and plot trends of AIC, BIC, and log likelihood statistics from `forsearch_lm`

**Author(s)**

William R. Fairweather

**References**

Atkinson, A and M Riani. Robust Diagnostic Regression Analysis, Springer, New York, 2000.

---

plotdiag.leverage      *Plot Diagnostic Statistics Of Leverage*

---

### Description

Plot output from `forsearch_lm` or `forsearch_lme` to show change in leverage of each observation as the number of observations in the forward search procedure increases. Save plot in folder containing working directory.

### Usage

```
plotdiag.leverage(forn, hilos = c(1, 0), maintitle = "Put main title here",
  subtitle = "Put subtitle here", caption="Put caption here", wmf = "Put_graph_title_here",
  Cairo=TRUE, printgraph = TRUE, verbose = TRUE)
```

### Arguments

<code>forn</code>	Name of forward search output file
<code>hilos</code>	Vector with number of highest observations and number of lowest observations on graph to identify
<code>maintitle</code>	Main title of plot
<code>subtitle</code>	Subtitle of plot
<code>caption</code>	Content of caption
<code>wmf</code>	File name of stored plot; omit ".wmf"
<code>Cairo</code>	TRUE causes use of Cairo graphics
<code>printgraph</code>	TRUE causes graph to print to file and closes device
<code>verbose</code>	If TRUE, indicates beginning and end of function

### Value

Process and plot Cook distance statistics from `forsearch_lm` or `forsearch_lme`

### Author(s)

William R. Fairweather

### References

Atkinson, A and M Riani. Robust Diagnostic Regression Analysis, Springer, New York, 2000.



---

plotdiag.loglik      *Plot Diagnostic Statistics of LOGLIK Output of COXPH Function*

---

### Description

Plot output from `forsearch_cph` to show change in loglik pairs as the number of observations in the forward search procedure increases. Save plot in folder containing working directory.

### Usage

```
plotdiag.loglik(forn,
  maintitle= "Put main title here",
  subtitle= "Put subtitle here" ,
  caption="Put caption here",
  wmf = "Put_stored_name_here",
  Cairo=TRUE,
  printgraph = TRUE,
  verbose=TRUE)
```

### Arguments

<code>forn</code>	Name of output file from <code>forsearch_cph</code>
<code>maintitle</code>	Main title of plot
<code>subtitle</code>	Subtitle of plot
<code>caption</code>	Content of caption
<code>wmf</code>	File name of stored plot; omit ".wmf"
<code>Cairo</code>	TRUE causes use of Cairo graphics
<code>printgraph</code>	TRUE causes graph to print to file and closes device
<code>verbose</code>	If TRUE, indicates beginning and end of function

### Value

Process and plot Wald Test statistics from `forsearch_cph`

### Author(s)

William R. Fairweather

### References

Atkinson, A and M Riani. Robust Diagnostic Regression Analysis, Springer, New York, 2000.

---

plotdiag.lrt

*Plot Diagnostic Statistics of Likelihood Ratio Test of COXPH Function*


---

### Description

Plot output from `forsearch_cph` to show change in likelihood ratio test as the number of observations in the forward search procedure increases. Save plot in folder containing working directory.

### Usage

```
plotdiag.lrt(forn,
  maintitle= "Put main title here",
  subtitle= "Put subtitle here" ,
  caption="Put caption here",
  wmf = "Put_graph_filename_here",
  Cairo=TRUE,
  printgraph = TRUE,
  addline=c("none", "loess", "straight"),
  verbose=TRUE)
```

### Arguments

<code>forn</code>	Name of output file from <code>forsearch_cph</code>
<code>maintitle</code>	Main title of plot
<code>subtitle</code>	Subtitle of plot
<code>caption</code>	Content of caption
<code>wmf</code>	File name of stored plot; omit ".wmf"
<code>Cairo</code>	TRUE causes use of Cairo graphics
<code>printgraph</code>	TRUE causes graph to print to file and closes device
<code>addline</code>	Add a line to the graph; abbreviation allowed. Default none
<code>verbose</code>	If TRUE, indicates beginning and end of function

### Value

Process and plot likelihood ratio test statistics from `forsearch_cph`

### Author(s)

William R. Fairweather

### References

Atkinson, A and M Riani. Robust Diagnostic Regression Analysis, Springer, New York, 2000.

---

plotdiag.params.fixed *Plot Diagnostic Statistics of Fixed Coefficients*

---

### Description

Plot output from `forsearch_XXX` to show change in fixed coefficients as the number of observations in the forward search procedure increases. Save plot in folder containing working directory.

### Usage

```
plotdiag.params.fixed(forn, coeff.codenums=NULL, maintitle = "Put main title here",
  subtitle = "Put subtitle here", caption="Put caption here", wmf = "Put_stored_name_here",
  Cairo=TRUE, printgraph=TRUE, legend = "Dummy legend name",
  verbose = TRUE)
```

### Arguments

<code>forn</code>	Name of output file from <code>forsearch_XXX</code>
<code>coeff.codenums</code>	Numeric vector of coefficients to include together on the plot. Codes are output by <code>identifyFixedCoeffs</code> (for <code>lm</code> files) or by <code>identifyCoeffs</code> function (for <code>lme</code> files)
<code>maintitle</code>	Main title of plot
<code>subtitle</code>	Subtitle of plot
<code>caption</code>	Content of caption
<code>wmf</code>	File name of stored plot; omit ".wmf"
<code>Cairo</code>	TRUE causes use of Cairo graphics
<code>printgraph</code>	TRUE causes graph to print to file and closes device
<code>legend</code>	Name of legend
<code>verbose</code>	If TRUE, indicates beginning and end of function

### Value

Process and plot fixed coefficient statistics from `forsearch_lm` or `forsearch_lme`

### Author(s)

William R. Fairweather

### References

Atkinson, A and M Riani. *Robust Diagnostic Regression Analysis*, Springer, New York, 2000.

---

plotdiag.params.random

*Plot Diagnostic Statistics Of Random Coefficients*

---

### Description

Plot output from `forsearch_lme` to show change in root mean squares of random coefficients as the number of observations in the forward search procedure increases. Save plot in folder containing working directory.

### Usage

```
plotdiag.params.random(forn, coeff.codenums=NULL, asfacets=FALSE, facetdir=c("h","v"),
  maintitle = "Put maintitle here", subtitle = "Put subtitle here",
  caption = "Put caption here", wmf = "Put_stored_name_here", Cairo=TRUE,
  printgraph = TRUE, legend = "Dummy legend name", verbose = TRUE)
```

### Arguments

<code>forn</code>	Name of output file from <code>forsearch_lme</code>
<code>coeff.codenums</code>	columns of output file to be included in graph
<code>asfacets</code>	TRUE causes printing in facets
<code>facetdir</code>	"v" lays out the facets vertically, "h" lays them out horizontally
<code>maintitle</code>	Main title of plot
<code>subtitle</code>	Subtitle of plot
<code>caption</code>	Content of caption
<code>wmf</code>	File name of stored plot; omit ".wmf"
<code>Cairo</code>	TRUE causes use of Cairo graphics
<code>printgraph</code>	TRUE causes graph to print to file and closes device
<code>legend</code>	Name of legend
<code>verbose</code>	If TRUE, indicates beginning and end of function

### Value

Process and plot RMS of random coefficients from `forsearch_lme`

### Author(s)

William R. Fairweather

### References

Atkinson, A and M Riani. Robust Diagnostic Regression Analysis, Springer, New York, 2000.

---

plotdiag.phihatx      *Plot Diagnostic PhiHat Statistics*

---

## Description

Plot output from `forsearch_glm` to show change in phiHat statistics as the number of observations in the forward search procedure increases. Save plot in folder containing working directory.

## Usage

```
plotdiag.phihatx(forn, maintitle = "Put main title here",
  subtitle = "Put subtitle here", caption="Put caption here",
  wmf = "Put_graph_filename_here",
  Cairo=TRUE, printgraph=TRUE, addline="none",
  verbose = TRUE)
```

## Arguments

<code>forn</code>	Name of output file from <code>forsearch_glm</code>
<code>maintitle</code>	Main title of plot
<code>subtitle</code>	Subtitle of plot
<code>caption</code>	Content of caption
<code>wmf</code>	File name of stored plot; omit ".wmf"
<code>Cairo</code>	TRUE causes use of Cairo graphics
<code>addline</code>	add a line to the graph; abbreviation allowed; "none", "loess", or "straight"
<code>printgraph</code>	TRUE causes graph to print to file and closes device
<code>verbose</code>	If TRUE, indicates beginning and end of function

## Value

Process and plot phiHat statistics from `forsearch_glm`

## Author(s)

William R. Fairweather

## References

Atkinson, A and M Riani. Robust Diagnostic Regression Analysis, Springer, New York, 2000.

---

plotdiag.residuals      *Plot Diagnostic Statistics Of Residuals Or Squared Residuals*

---

### Description

Plot output from `forsearch_lm` or `forsearch_lme` to show change in residuals or squared residuals as the number of observations in the forward search procedure increases. Save plot in folder containing working directory.

### Usage

```
plotdiag.residuals(forn, squared = FALSE, hilos = c(1, 0), maintitle, subtitle,
caption, wmf, Cairo=TRUE, printgraph=TRUE,
legend = "Dummy legend name", verbose = TRUE)
```

### Arguments

<code>forn</code>	Name of forward search output file
<code>squared</code>	TRUE causes residuals to be squared before plotting
<code>hilos</code>	Number of observations having high and number having low values of residuals to identify. No low values are identified for squared residual plot.
<code>maintitle</code>	Main title of plot
<code>subtitle</code>	Subtitle of plot
<code>caption</code>	Caption of plot
<code>wmf</code>	File name of stored plot; omit ".wmf"
<code>Cairo</code>	TRUE causes use of Cairo graphics
<code>printgraph</code>	TRUE causes graph to print to file and closes device
<code>legend</code>	Legend title
<code>verbose</code>	If TRUE, indicates beginning and end of function

### Value

Process and plot changes in residuals or squared residuals from `forsearch_lm` or `forsearch_lme`

### Author(s)

William R. Fairweather

### References

Atkinson, A and M Riani. Robust Diagnostic Regression Analysis, Springer, New York, 2000.

**Description**

Plot output from `forsearch_lm` to show change in residual variation as the number of observations in the forward search procedure increases. Save plot in folder containing working directory.

**Usage**

```
plotdiag.s2(forn, maintitle = "Put main title here", subtitle = "Put subtitle here",  
caption = "Put caption here", wmf = "Put_graph_filename_here",  
Cairo=TRUE, printgraph=TRUE, addline = c("none", "loess", "straight"),  
verbose = TRUE)
```

**Arguments**

<code>forn</code>	Name of output file from <code>forsearch_lm</code>
<code>maintitle</code>	Main title of plot
<code>subtitle</code>	Subtitle of plot
<code>caption</code>	Content of caption
<code>wmf</code>	File name of stored plot; omit ".wmf"
<code>Cairo</code>	TRUE causes use of Cairo graphics
<code>printgraph</code>	TRUE causes graph to print to file and closes device
<code>addline</code>	add a line to the graph; abbreviation allowed
<code>verbose</code>	If TRUE, indicates beginning and end of function

**Value**

Process and plot residual variation statistics from `forsearch_lm`

**Author(s)**

William R. Fairweather

**References**

Atkinson, A and M Riani. Robust Diagnostic Regression Analysis, Springer, New York, 2000.

---

plotdiag.tstats      *Plot Diagnostic T Statistics*

---

### Description

Plot output from `forsearch_lm` or `forsearch_lme` to show change in t statistics as the number of observations in the forward search procedure increases. Save plot in folder containing working directory.

### Usage

```
plotdiag.tstats(forn, coeff.codenums=NULL, maintitle = "Put main title here",
  subtitle = "Put subtitle here", caption="Put caption here", wmf = "Put_stored_name_here",
  Cairo=TRUE, printgraph=TRUE, legend = "Dummy legend name",
  verbose = TRUE)
```

### Arguments

<code>forn</code>	Name of output file from <code>forsearch_lm</code> or <code>forsearch_lme</code>
<code>coeff.codenums</code>	Numeric vector of coefficients to include together on the plot. Codes are output by <code>identifyFixedCoeffs</code> (for lm files) or by <code>identifyCoeffs</code> function (for lme files)
<code>maintitle</code>	Main title of plot
<code>subtitle</code>	Subtitle of plot
<code>caption</code>	Content of caption
<code>wmf</code>	File name of stored plot; omit ".wmf"
<code>Cairo</code>	TRUE causes use of Cairo graphics
<code>printgraph</code>	TRUE causes graph to print to file and closes device
<code>legend</code>	Name of legend
<code>verbose</code>	If TRUE, indicates beginning and end of function

### Value

Process and plot t statistics of fixed coefficients from `forsearch_lm` or `forsearch_lme`

### Author(s)

William R. Fairweather

### References

Atkinson, A and M Riani. *Robust Diagnostic Regression Analysis*, Springer, New York, 2000.



---

plotdiag.Wald

*Plot Diagnostic Statistics of Wald Test Output of COXPH Function*


---

**Description**

Plot output from `forsearch_cph` to show change in Wald test as the number of observations in the forward search procedure increases. Save plot in folder containing working directory.

**Usage**

```
plotdiag.Wald(forn,
maintitle= "Put main title here",
subtitle= "Put subtitle here" ,
caption="Put caption here",
wmf = "Put_graph_filename_here",
Cairo=TRUE,
printgraph = TRUE,
addline=c("none","loess","straight"),
verbose=TRUE)
```

**Arguments**

<code>forn</code>	Name of output file from <code>forsearch_cph</code>
<code>maintitle</code>	Main title of plot
<code>subtitle</code>	Subtitle of plot
<code>caption</code>	Content of caption
<code>wmf</code>	File name of stored plot; omit ".wmf"
<code>Cairo</code>	TRUE causes use of Cairo graphics
<code>printgraph</code>	TRUE causes graph to print to file and closes device
<code>addline</code>	Add a line to the graph; abbreviation allowed. Default none
<code>verbose</code>	If TRUE, indicates beginning and end of function

**Value**

Process and plot Wald Test statistics from `forsearch_cph`

**Author(s)**

William R. Fairweather

**References**

Atkinson, A and M Riani. Robust Diagnostic Regression Analysis, Springer, New York, 2000.

---

search.history	<i>Create Tabular History Of Forward Search</i>
----------------	---

---

### Description

The forward search functions output a list of vectors, each of which indicates which observations are in the model at each stage of the search. This function processes that list to create a more easily understood matrix of the observation numbers that are newly entered into the model and any that were temporarily removed from the model over the course of the search.

### Usage

```
search.history(list1, verbose = TRUE)
```

### Arguments

list1	Name of a forsearch_XXX output file
verbose	If TRUE, indicates beginning and end of function

### Value

Printout of matrix showing evolution of observations to enter or leave the model during the course of the forward search

### Author(s)

William R. Fairweather

### Examples

```
info3 <- system.file("extdata", "crossdata.for1.R", package="forsearch");
info3 <- source(info3);
info3 <- info3[[1]];
search.history(list1=info3, verbose=TRUE)
```

---

showme	<i>Display Abbreviated Output of FORSEARCH_XXX Function</i>
--------	---

---

### Description

Output of forsearch\_XXX function can be voluminous. This function displays the output in an abbreviated format. Primarily for programmer use.

### Usage

```
showme(x, verbose = TRUE)
```

**Arguments**

x                    Name of forsearch\_XXX output file  
 verbose            If TRUE, indicates the beginning and end of function run

**Value**

Abbreviated printout of output of forsearch\_lm function

**Author(s)**

William R. Fairweather

---

variablelist                    *Identify Level(s) to Which Each Factor Observation Belongs*

---

**Description**

For a data frame with factor variables V1, V2, V3, etc having levels n1, n2, n3, etc, lists the  $n1*n2*n3*...$  possible interaction levels and identifies which of the observations of the data frame belong in which of these interaction levels.

**Usage**

```
variablelist(datadf, prank)
```

**Arguments**

datadf                Data frame of independent variables in analysis. First column of data frame is Observation number  
 prank                Number of continuous variables among independent variables

**Details**

Support function, usually not called independently

**Value**

List, each element is a data frame of 2 columns with code indicating the highest possible level of interaction to which each observation can belong

**Author(s)**

William R. Fairweather

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