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Description

This package provides profile likelihoods for a parameter of interest in commonly used statistical models. The models include linear models, generalized linear models, proportional odds models, linear mixed-effects models, and linear models for longitudinal responses fitted by generalized least squares. The package also provides plots for normalized profile likelihoods as well as the maximum profile likelihood estimates and the kth likelihood support intervals.

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Profile Likelihood for a Parameter in Commonly Used Statistical Models

Description

This package provides profile likelihoods for a parameter of interest in commonly used statistical models. The models include linear models, generalized linear models, proportional odds models, linear mixed-effects models, and linear models for longitudinal responses fitted by generalized least squares. The package also provides plots for normalized profile likelihoods as well as the maximum profile likelihood estimates and the kth likelihood support intervals (Royall, 1997).

Details

Package: ProfileLikelihood
Type: Package
Version: 1.0
Date: 2011-01-25
License: GPL (>=3)
LazyLoad: yes

Use `profilelike.lm`, `profilelike(glm)`, `profilelike.polr`, `profilelike.gls` and `profilelike.lme` to obtain profile likelihoods and normalized profile likelihoods, and plot the normalized profile likelihoods using `profilelike.plot`. Use `profilelike.summary` to obtain the maximum profile likelihood estimate and the kth likelihood support intervals.

Author(s)

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References


See Also

`profilelike.lm`, `profilelike(glm)`, `profilelike.polr`, `profilelike.gls`, `profilelike.lme`, `profilelike.plot`, `profilelike.summary`
Examples

c <- c(4.17, 5.58, 5.18, 6.11, 4.50, 4.61, 5.17, 4.53, 5.33, 5.14)
t <- c(4.81, 4.17, 4.41, 3.59, 5.87, 3.83, 6.03, 4.89, 4.32, 4.69)
group <- c(rep(0, 10), rep(1, 10))
weight <- c(c(t, t))

d <- data.frame(group = group, weight = weight)
x <- profilelike(glm(formula = weight ~ 1, data = d, profile.theta = "group",
lo.theta = -2, hi.theta = 1, length = 500)
profilelike.plot(theta = x$theta, profile.lik.norm = x$profile.lik.norm, round = 2)

Description

This data is used to illustrate how to obtain values for a profile likelihood of a parameter of interest in a generalized linear model.

Usage

data(dataglm)

Format

A data frame with 100 observations on the following 5 variables.

id a numeric vector; unique identification number
y a numeric vector; binary outcome variable
x1 a numeric vector; covariate
x2 a numeric vector; covariate
group a numeric vector; covariate and a parameter of interest

Details

This data is used to illustrate how to obtain values for a profile likelihood of a parameter of interest in a logistic regression model. A parameter of interest is group indicator variable, y is a binary outcome, and x1 and x2 are covariates in a logistic regression model.

Examples

data(dataglm)
x <- profilelike.glm(y ~ x1 + x2, data = dataglm, profile.theta = "group",
family = binomial(link = "logit"), length = 500, round = 2)
profilelike.plot(theta = x$theta, profile.lik.norm = x$profile.lik.norm, round = 2)
Example Data for a Profile Likelihood in Proportional Odds Models

**Description**

This data is used to illustrate how to obtain values for a profile likelihood of a parameter of interest in a proportional odds model.

**Usage**

```r
data(datapolr)
```

**Format**

A data frame with 66 observations on the following 5 variables.

- `id`  a numeric vector; unique identification number
- `y`  a numeric vector; ordinal outcome variable; should be defined as a factor
- `x1`  a numeric vector; covariate
- `x2`  a numeric vector; covariate
- `group`  a numeric vector; covariate and a parameter of interest

**Details**

This data is used to illustrate how to obtain values for a profile likelihood of a parameter of interest in a proportional odds model. A parameter of interest is `group` indicator variable, `y` is an ordinal outcome, and `x1` and `x2` are covariates in a proportional odds model.

**Examples**

```r
data(datapolr)
datapolr$y <- as.factor(datapolr$y)
xx <- profilelike.polr(y ~ x1 + x2, data=datapolr, profile.theta="group",
method="logistic", lo.theta=-2, hi.theta=2.5, length=500)
profilelike.plot(theta=xx$theta, profile.lik.norm=xx$profile.lik.norm, round=2)
```
Description

This function provides p-values based on likelihood ratio (LR) statistics for 2 x 2 tables.

Usage

LR.pvalue(y1L y2, n1, n2, interval=0.01)

Arguments

y1 the number of success for treatment 1.
y2 the number of success for treatment 2.
n1 the sample size for treatment 1.
n2 the sample size for treatment 2.
interval grid for evaluating a parameter of interest to obtain values for likelihoods. The default is 0.01.

Details

This function provides p-values based on the profile and conditional likelihood ratio (LR) statistics for 2 x 2 tables. The function also provides the profile and conditional likelihood support intervals (k=6.8) corresponding to a 95% confidence interval based on a normal approximation. For comparison purpose, p-values from Pearson’s Chi-squared test, Fisher’s exact test and Pearson’s Chi-squared test with continuity correction are also provided.

Value

mle.lor.uncond the maximum likelihood estimate for log odds ratio.
mle.lor.cond the maximum conditional likelihood estimate for log odds ratio.
LI.norm.profile profile likelihood support interval (k=6.8) corresponding to a 95% confidence interval based on a normal approximation.
LI.norm.cond conditional likelihood support interval (k=6.8) corresponding to a 95% confidence interval based on a normal approximation.
LR.profile profile likelihood ratio.
LR.cond conditional likelihood ratio.
Pvalue.LR.profile p-value based on the profile LR statistic.
Pvalue.LR.cond p-value based on the conditional LR statistic.
**Pvalue.chisq.test**
- p-value from Pearson’s Chi-squared test.

**Pvalue.fisher.test**
- p-value from Fisher’s exact test.

**Pvalue.chisq.cont.correction**
- p-value from Pearson’s Chi-squared test with continuity correction.

**Warning**

Likelihood intervals, LRs and the corresponding p-values are not reliable with empty cells (y1=0 or y2=0) in 2 x 2 tables.

P-values from Pearson’s Chi-squared test, Fisher’s exact test and Pearson’s Chi-squared test with continuity correction are provided only for comparison purpose. For more options, use `chisq.test` and `fisher.test` for these tests.

**Author(s)**

Leena Choi <leena.choi@Vanderbilt.Edu>

**See Also**

`profilelike.plot`, `profilelike.summary`, `profilelike(glm)`

**Examples**

```r
(fit <- LR.pvalue(y1=20, y2=30, n1=50, n2=50, interval=0.01))
```

---

**Description**

This function provides values for a profile likelihood and a normalized profile likelihood for a parameter of interest in a generalized linear model.

**Usage**

```
profilelike glm(formula, data, profile.theta, family = gaussian, offset glm = NULL, lo.theta = NULL, hi.theta = NULL, length = 300, round = 2, subset = NULL, weights = NULL, offset = NULL, ...)
```
Arguments

- **formula**: see corresponding documentation in `glm`.
- **data**: a data frame. See corresponding documentation in `glm`.
- **profile.theta**: a parameter of interest, theta; must be a numeric variable.
- **family**: see corresponding documentation in `glm`.
- **offset.glm**: same usage as offset in `glm`. See corresponding documentation for offset in `glm`.
- **lo.theta**: lower bound for a parameter of interest to obtain values for a profile likelihood.
- **hi.theta**: upper bound for a parameter of interest to obtain values for a profile likelihood.
- **length**: length of numerical grid values for a parameter of interest to obtain values for a profile likelihood.
- **round**: the number of decimal places for `round` function to automatically define lower and upper bounds of numerical grid for a parameter of interest. If an automatically defined parameter range is not appropriate, increase the number or specify `lo.theta` and `hi.theta`.
- **subset**: should not be provided.
- **weights**: should not be provided.
- **offset**: should not be provided. Instead use `offset.glm`.
- **...**: further arguments passed to or from other methods.

Details

This function provides values for a profile likelihood and a normalized profile likelihood for a parameter of interest in a generalized linear model. Users must define a parameter of interest in a generalized linear model. This function can be used for generalized linear models comparable with the `glm` function. However, arguments `weights`, `subset`, and `offset` should not be provided. An argument `offset` in `glm` function can be provided using `offset.glm`. A normalized profile likelihood is obtained by a profile likelihood being divided by the maximum value of the profile likelihood so that a normalized profile likelihood ranges from 0 to 1.

Value

- **theta**: numerical grid values for a parameter of interest in a specified range (between lower and upper bounds).
- **profile.lik**: numerical values for a profile likelihood corresponding to theta in a specified range (between lower and upper bounds).
- **profile.lik.norm**: numerical values for a normalized profile likelihood ranging from 0 to 1.

Warning

Arguments `weights`, `subset`, and `offset` in the `glm` function are not comparable.

Missing values should be removed.
Author(s)

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See Also

profilelike.plot, profilelike.summary, profilelike.lm, profilelike.polr, profilelike.gls, profilelike.lme, glm

Examples

data(dataglm)
xx <- profilelike.glm(y ~ x1 + x2, data=dataglm, profile.theta="group",
family=binomial(link="logit"), length=500, round=2)
profilelike.plot(theta=xx$theta, profile.lik.norm=xx$profile.lik.norm, round=2)

profilelike.gls  Profile Likelihood for Linear Models for Longitudinal Responses Fitted by Generalized Least Squares

Description

This function provides values for a profile likelihood and a normalized profile likelihood for a parameter of interest in a linear model for longitudinal responses fitted by generalized least squares.

Usage

profilelike.gls(formula, data, correlation = NULL, subject, profile.theta,
method = "ML", lo.theta, hi.theta, length = 300, round = 2,
subset = NULL, weights = NULL, ...)

Arguments

formula  see corresponding documentation in gls.

data  a data frame. See corresponding documentation in gls.
correlation  see corresponding documentation in gls.
subject  see corresponding documentation in gls.
profile.theta  a parameter of interest, theta; must be a numeric variable.
method  see corresponding documentation in gls.
lo.theta  lower bound for a parameter of interest to obtain values for a profile likelihood.
hi.theta  upper bound for a parameter of interest to obtain values for a profile likelihood.
length  length of numerical grid values for a parameter of interest to obtain values for a profile likelihood.
round  the number of decimal places for round function to automatically define lower and upper bounds of numerical grid for a parameter of interest. If an automatically defined parameter range is not appropriate, increase the number or specify lo.theta and hi.theta.
profilelike.gls

subset should not be provided.
weights should not be provided.
... further arguments passed to or from other methods.

Details

This function provides values for a profile likelihood and a normalized profile likelihood for a parameter of interest in a linear model for longitudinal responses fitted by generalized least squares. Users must define a parameter of interest in the model. This function can be used for models for longitudinal responses comparable with the gls function. However, arguments weights and subset should not be provided. A normalized profile likelihood is obtained by a profile likelihood being divided by the maximum value of the profile likelihood so that a normalized profile likelihood ranges from 0 to 1.

Value

theta numerical grid values for a parameter of interest in a specified range (between lower and upper bounds).
profile.lik numerical values for a profile likelihood corresponding to theta in a specified range (between lower and upper bounds).
profile.lik.norm numerical values for a normalized profile likelihood ranging from 0 to 1.

Warning

Arguments weights and subset in the gls function are not comparable.
Missing values should be removed.

Author(s)

Leena Choi <leena.choi@Vanderbilt.Edu>

See Also

profilelike.plot, profilelike.summary, profilelike.lm, profilelike(glm, profilelike.polr, profilelike.lme, gls

Examples

xx <- profilelike.gls(formula=yield ~ endpoint, correlation=corAR1(form = ~ 1 | id),
data=Gasoline, subject="Sample", profile.theta="vapor", method="ML",
lo.theta=1, hi.theta=5, length=500, round=2)
profilelike.plot(theta=xx$theta, profile.lik.norm=xx$profile.lik.norm, round=4)
Description

This function provides values for a profile likelihood and a normalized profile likelihood for a parameter of interest in a linear model.

Usage

profilelike.lm(formula, data, profile.theta, lo.theta = NULL, hi.theta = NULL, length = 300, round = 2, subset = NULL, weights = NULL, offset = NULL, ...)

Arguments

formula see corresponding documentation in lm.
data a data frame. See corresponding documentation in lm.
profile.theta a parameter of interest, theta; must be a numeric variable.
lo.theta lower bound for a parameter of interest to obtain values for a profile likelihood.
hi.theta upper bound for a parameter of interest to obtain values for a profile likelihood.
length length of numerical grid values for a parameter of interest to obtain values for a profile likelihood.
round the number of decimal places for round function to automatically define lower and upper bounds of numerical grid for a parameter of interest. If an automatically defined parameter range is not appropriate, increase the number or specify lo.theta and hi.theta.
subset should not be provided.
weights should not be provided.
offset should not be provided.
... further arguments passed to or from other methods.

Details

This function provides values for a profile likelihood and a normalized profile likelihood for a parameter of interest in a linear model. Users must define a parameter of interest in a linear model. This function can be used for linear models comparable with the lm function. However, arguments weights, subset, and offset should not be provided. A normalized profile likelihood is obtained by a profile likelihood being divided by the maximum value of the profile likelihood so that a normalized profile likelihood ranges from 0 to 1.
Value

theta  numerical grid values for a parameter of interest in a specified range (between lower and upper bounds).
profile.lik  numerical values for a profile likelihood corresponding to theta in a specified range (between lower and upper bounds).
profile.lik.norm  numerical values for a normalized profile likelihood ranging from 0 to 1.

Warning

Arguments weights, subset, and offset in the lm function are not comparable.
Missing values should be removed.

Author(s)

Leena Choi <leena.choi@Vanderbilt.Edu>

See Also

profilelike.plot, profilelike.summary, profilelike.glm, profilelike.polr, profilelike.gls, profilelike.lme, lm

Examples

c1t <- c(4.17,5.58,5.18,6.11,4.50,4.61,5.17,4.53,5.33,5.14)
trt <- c(4.81,4.17,4.41,3.59,5.87,3.83,6.03,4.89,4.32,4.69)
group <- c(rep(0,10), rep(110))
weight <- c(ctl trt)
dd <- data.frame(group=group, weight=weight)
xx <- profilelike.lm(formula = weight ~ 1, data=dd, profile.theta="group", lo.theta=-2, hi.theta=1, length=500)
profilelike.plot(theta=xx$theta, profile.lik.norm=xx$profile.lik.norm, round=2)

profilelike.lme Profile Likelihood for Linear Mixed-Effects Models

Description

This function provides values for a profile likelihood and a normalized profile likelihood for a parameter of interest in a linear mixed-effects model.

Usage

profilelike.lme(formula, data, subject, random, correlation = NULL, profile.theta, method = "ML", lo.theta, hi.theta, length = 300, round = 2, subset = NULL, weights = NULL, ...)
Arguments

- **formula**: see corresponding documentation in `lme`.
- **data**: a data frame. See corresponding documentation in `lme`.
- **subject**: see corresponding documentation in `lme`.
- **random**: see corresponding documentation in `lme`.
- **correlation**: see corresponding documentation in `lme`.
- **profile.theta**: a parameter of interest, theta; must be a numeric variable.
- **method**: see corresponding documentation in `lme`.
- **lo.theta**: lower bound for a parameter of interest to obtain values for a profile likelihood.
- **hi.theta**: upper bound for a parameter of interest to obtain values for a profile likelihood.
- **length**: length of numerical grid values for a parameter of interest to obtain values for a profile likelihood.
- **round**: the number of decimal places for `round` function to automatically define lower and upper bounds of numerical grid for a parameter of interest. If an automatically defined parameter range is not appropriate, increase the number or specify `lo.theta` and `hi.theta`.
- **subset**: should not be provided.
- **weights**: should not be provided.
- **...**: further arguments passed to or from other methods.

Details

This function provides values for a profile likelihood and a normalized profile likelihood for a parameter of interest in a linear mixed-effects model. Users must define a parameter of interest in a linear mixed-effects model. This function can be used for models comparable with the `lme` function. However, arguments weights and subset should not be provided. A normalized profile likelihood is obtained by a profile likelihood being divided by the maximum value of the profile likelihood so that a normalized profile likelihood ranges from 0 to 1.

Value

- **theta**: numerical grid values for a parameter of interest in a specified range (between lower and upper bounds).
- **profile.lik**: numerical values for a profile likelihood corresponding to theta in a specified range (between lower and upper bounds).
- **profile.lik.norm**: numerical values for a normalized profile likelihood ranging from 0 to 1.

Warning

Arguments weights and subset in the `lme` function are not comparable.

Missing values should be removed.
Description

The function provides a plot for a normalized profile likelihood as well as the maximum profile likelihood estimate and the kth likelihood support intervals (Royall, 1997).

Usage

profilelike.plot(theta = theta, profile.lik.norm = profile.lik.norm, round = 2)

Arguments

theta numerical grid values for a parameter of interest in a specified range.
profile.lik.norm numerical values for a normalized profile likelihood ranging from 0 to 1.
round the number of decimal places for round function for presentation of the maximum profile likelihood estimate and the kth likelihood support intervals.

Details

The function provides a plot for a normalized profile likelihood obtained from profilelike.lm, profilelike.glm, profilelike.polar, profilelike.gls and profilelike.lme. The maximum profile likelihood estimate, the kth likelihood support interval (k=8, k=20, and k=32), and the likelihood support interval (k=6.8) corresponding to a 95% confidence interval based on a normal approximation are also presented.

Value

A normalized profile likelihood plot with the maximum profile likelihood estimate and the kth likelihood support intervals.
profilelike.polr

Author(s)
Leena Choi <leena.choi@Vanderbilt.Edu>

References

See Also
profilelike.summary, profilelike.lm, profilelike.glm, profilelike.polr, profilelike.gls, profilelike.lme

Examples
ctl <- c(4.17, 5.58, 5.18, 6.11, 4.58, 4.61, 5.17, 4.53, 5.33, 5.14)
trt <- c(4.81, 4.17, 4.41, 3.59, 5.87, 3.83, 6.03, 4.91, 4.89, 4.32, 4.69)
group <- c(rep(0,10), rep(1,10))
weight <- c(ctl, trt)
xx <- data.frame(group=group, weight=weight)
x <- profilelike.lm(formula = weight ~ 1, data=xx, profile.theta="group",
lo.theta=-2, hi.theta=1, length=500)
profilelike.plot(theta=xx$theta, profile.lik=xx$profile.lik.norm, round=2)
profilelike.summary(k=8, theta=xx$theta, profile.lik=xx$profile.lik.norm, round=3)

profilelike.polr

Profile Likelihood for Proportional Odds Models

Description
This function provides values for a profile likelihood and a normalized profile likelihood for a parameter of interest in a proportional odds model.

Usage
profilelike.polr(formula, data, profile.theta, method = "logistic",
lo.theta = NULL, hi.theta = NULL, length = 300, round = 2,
subset = NULL, weights = NULL, offset = NULL, ...)

Arguments
formula see corresponding documentation in polr.
data a data frame. See corresponding documentation in polr.
profile.theta a parameter of interest, theta; must be a numeric variable.
method see corresponding documentation in polr.
**profilelike.polr**

- `lo.theta` lower bound for a parameter of interest to obtain values for a profile likelihood.
- `hi.theta` upper bound for a parameter of interest to obtain values for a profile likelihood.
- `length` length of numerical grid values for a parameter of interest to obtain values for a profile likelihood.
- `round` the number of decimal places for round function to automatically define lower and upper bounds of numerical grid for a parameter of interest. If an automatically defined parameter range is not appropriate, increase the number or specify `lo.theta` and `hi.theta`.
- `subset` should not be provided.
- `weights` should not be provided.
- `offset` should not be provided.
- `...` further arguments passed to or from other methods.

**Details**

This function provides values for a profile likelihood and a normalized profile likelihood for a parameter of interest in a proportional odds model. Users must define a parameter of interest in a proportional odds model. This function can be used for proportional odds models comparable with the `polr` function. However, arguments weights, subset, and offset should not be provided. A normalized profile likelihood is obtained by a profile likelihood being divided by the maximum value of the profile likelihood so that a normalized profile likelihood ranges from 0 to 1.

**Value**

- `theta` numerical grid values for a parameter of interest in a specified range (between lower and upper bounds).
- `profile.lik` numerical values for a profile likelihood corresponding to theta in a specified range (between lower and upper bounds).
- `profile.lik.norm` numerical values for a normalized profile likelihood ranging from 0 to 1.

**Warning**

Arguments weights, subset, and offset in the `polr` function are not comparable.

Missing values should be removed.

**Author(s)**

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**See Also**

`profilelike.plot, profilelike.summary, profilelike.lm, profilelike.glm, profilelike.gls, profilelike.lme, polr`
Examples

```r
data(datapolr)
datapolr$y <- as.factor(datapolr$y)
xx <- profilelike.polr(y ~ x1 + x2, data=datapolr, profile.theta="group",
  method="logistic", lo.theta=-2, hi.theta=2.5, length=500)
profilelike.plot(theta=xx$theta, profile.lik.norm=xx$profile.lik.norm, round=2)
```

profilelike.summary Summary for the Maximum Profile Likelihood Estimate and Likelihood Support Intervals

Description

The function provides the maximum profile likelihood estimate and likelihood support intervals (Royall, 1997).

Usage

```r
profilelike.summary(k, theta = theta, profile.lik.norm = profile.lik.norm,
  round = 2)
```

Arguments

- `k`: strength of evidence for the kth likelihood support interval.
- `theta`: numerical grid values for a parameter of interest in a specified range.
- `profile.lik.norm`: numerical values for a normalized profile likelihood ranging from 0 to 1.
- `round`: the number of decimal places for `round` function for presentation of the maximum profile likelihood estimate and the kth likelihood support intervals.

Details

The function provides the maximum profile likelihood estimate and likelihood support intervals for a profile likelihood obtained from `profilelike.lm`, `profilelike.glm`, `profilelike.polr`, `profilelike.gls` and `profilelike.lme`. The kth likelihood support interval and the likelihood support interval (k=6.8) corresponding to a 95% confidence interval based on a normal approximation are provided.

Value

- `k`: strength of evidence for the kth likelihood support interval.
- `mle`: the maximum profile likelihood estimate.
- `LI.k`: the kth likelihood support interval.
- `LI.norm`: likelihood support interval (k=6.8) corresponding to a 95% confidence interval based on a normal approximation.
Author(s)

Leena Choi <leena.choi@Vanderbilt.Edu>

References


See Also

profilelike.plot, profilelike.lm, profilelike.glm, profilelike.polar, profilelike.gls, profilelike.lme

Examples

ctl <- c(4.47, 5.58, 5.18, 6.11, 4.50, 4.61, 5.17, 4.53, 5.33, 5.14)
trt <- c(4.81, 4.17, 4.41, 3.59, 5.87, 3.83, 6.03, 4.89, 4.32, 4.69)
group <- c(rep(0, 10), rep(1, 10))
weight <- c(ctl, trt)
dd <- data.frame(group=group, weight=weight)
xx <- profilelike.lm(formula = weight ~ 1, data=dd, profile.theta="group",
lo.theta=-2, hi.theta=1, length=500)
profilelike.plot(theta=xx$theta, profile.lik.norm=xx$profile.lik.norm, round=2)
profilelike.summary(k=8, theta=xx$theta, profile.lik.norm=xx$profile.lik.norm, round=3)
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