

Package ‘FertBoot’

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Type Package

Title Fertilizer Response Curve Analysis by Bootstrapping Residuals

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Description

Quantify variability (such as confidence interval) of fertilizer response curves and optimum fertilizer rates using bootstrapping residuals with several popular non-linear and linear models.

Imports stats, nls.multstart, simpleboot

License GPL-2

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LazyData true

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boot.CI	<i>Bootstrap confidence intervals of mean</i>
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Description

Bootstrap confidence intervals of mean

Usage

```
boot.CI(x, alpha = 0.05, CI.type = "all")
```

Arguments

x	a vector of observation
alpha	significance level (default: 0.05)
CI.type	type of CI required (default: "all")

Value

boot.CI return list of confidence intervals of mean (CI.percent: percentile, CI.BC: bias-corrected and CI.BCa: bias-corrected and accelerated).

Examples

```
set.seed(12)
boot.CI(rnorm(1000, mean=0, sd=1), alpha=0.05, CI.type="per") # example of wrong input for type
boot.CI(rnorm(1000, mean=0, sd=1), alpha=0.05, CI.type="all") # require all type
```

boot.resid.linear.plateau	<i>Linear plateau model estimation by bootstrapping residuals</i>
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Description

boot.resid.linear.plateau is the core function to implement bootstrapping residuals on linear plateau models, which assumes $y \sim a + b * (x - c) * (x \leq c)$. Note that this function may take minutes up to days. Parallel computing may be necessary. We suggest users start with a smaller B and moderate n.start to see if the bootstrap models can converge. In general, increasing n.start and plus_minus may help with ease of convergence. For rigorous statistical inference, B should be on the order of a thousand.

Usage

```
boot.resid.linear.plateau(
  mod,
  data,
  x.range = data.frame(x = seq(0, 280, by = 40)),
  B = 100 - 1,
  plus_minus = 100,
  n.start = 1000,
  print.progress = TRUE
)
```

Arguments

mod	a full model list, probably from <code>f.linear.plateau()</code>
data	data frame with two columns (x and y)
x.range	vector of data.frame with one column for range of N rate of interested for prediction interval
B	bootstrap sample size
plus_minus	radius of random initial values (default: 100)
n.start	total number of initial points considered (default: 1000)
print.progress	logical flag whether printing progress

Value

`boot.resid.linear.plateau` returns a list of two elements: `result`: matrix with B rows and columns containing bootstrap sample for parameter (a, b, c), optimal N and yield (`max_x`, `max_y`), log-likelihood (`logLik`) and N values of interest; `x.range`: range of x considered for prediction interval (same as `x.range` in vector form)

Examples

```
set.seed(1)
x <- rep(1:300, each=4)
a <- 8; b <- 0.05; c <- 100
y <- a + b * (x - c) * (x <= c) +
  rnorm(length(x), sd=1)
d <- cbind(x,y)

# a converged example:
ans <- f.linear.plateau(d, start=list(a = 7, b = 0.1, c = 150),
  plus_minus=10, n.start=10, msg=FALSE)

ans.boot <- boot.resid.linear.plateau(ans, d, x.range=seq(0,280,by=40),
  B=9, plus_minus = 1e2, n.start=1000, print.progress=TRUE) # use larger B for inference
```

boot.resid.quad *Fitting quadratic model using multiple initial values*

Description

boot.resid.linear.plateau is the core function to implement bootstrapping residuals on quadratic models, which assumes $y \sim a+b*x+c*x^2$. Note that this function may take minutes up to days. Parallel computing may be necessary. We suggest users start with a smaller B and moderate n.start to see if the bootstrap models can converge. In general, increasing n.start and plus_minus may help with ease of convergence. For rigorous statistical inference, B should be on the order of a thousand.

Usage

```
boot.resid.quad(
  mod,
  data,
  x.range = data.frame(x = seq(0, 280, by = 40)),
  B = 100 - 1,
  plus_minus = 10,
  n.start = 20,
  print.progress = TRUE
)
```

Arguments

mod	a full model list, probably from f.quad.plateau()
data	data frame with two columns (x and y)
x.range	vector of data.frame with one column for range of N rate of interested for prediction interval
B	bootstrap sample size
plus_minus	radius of random initial values (default: 10)
n.start	total number of initial points considered (default: 20)
print.progress	logical flag whether printing progress

Value

boot.resid.quad.plateau returns a list of two elements: result: matrix with B rows and columns containing bootstrap sample for parameter (a, b, c), optimal N and yield (max_x, max_y), log-likelihood (logLik) and N values of interest; x.range: range of x considered for prediction interval (same as x.range in vector form)

Examples

```

set.seed(1)
x <- rep(1:300, each=5)
a <- 8; b <- 0.05; c <- -1e-3
y <- (a + b * x + c *x^2) + rnorm(length(x), sd=0.1)
d <- cbind(x,y)

ans <- f.quad(d, start=list(a = 7, b = 0.02, c = 1e-5),
  plus_minus=10, n.start=10, msg=FALSE)

ans.boot <- boot.resid.quad(ans, d, x.range=seq(0,280,by=40),
  B=1e1-1, plus_minus = 1e1, n.start=20, print.progress=TRUE) # use larger B for inference

```

```
boot.resid.quad.plateau
```

Quadratic plateau model estimation by bootstrapping residuals

Description

`boot.resid.quad.plateau` is the core function to implement bootstrapping residuals on quadratic plateau models, which assumes $y = (a + b * x + c *x^2) * (x \leq -0.5*b/c) + (a + -b^2/(4 * c)) * (x > -0.5 * b/c)$. Note that this function may take minutes up to days. Parallel computing may be necessary. We suggest users start with a smaller B and moderate n.start to see if the bootstrap models can converge. In general, increasing n.start and plus_minus may help with ease of convergence. For rigorous statistical inference, B should be on the order of a thousand.

Usage

```

boot.resid.quad.plateau(
  mod,
  data,
  x.range = data.frame(x = seq(0, 280, by = 40)),
  B = 100 - 1,
  plus_minus = 100,
  n.start = 5000,
  print.progress = TRUE
)

```

Arguments

mod	a full model list, probably from <code>f.quad.plateau()</code>
data	data frame with two columns (x and y)
x.range	vector of data.frame with one column for range of N rate of interested for prediction interval
B	bootstrap sample size
plus_minus	radius of random initial values (default: 100)
n.start	total number of initial points considered (default: 1000)
print.progress	logical flag whether printing progress

Value

`boot.resid.quad.plateau` returns a list of two elements: `result`: matrix with B rows and columns containing bootstrap sample for parameter (a, b, c), optimal N and yield (`max_x`, `max_y`), log-likelihood (`logLik`) and N values of interest; `x.range`: range of x considered for prediction interval (same as `x.range` in vector form)

Examples

```
set.seed(1)
x <- rep(1:300, each=5)
a <- 8; b <- 0.05; c <- -1e-4
y <- (a + b * x + c * x^2) * (x <= -0.5*b/c) + (a + -b^2/(4 * c)) * (x > -0.5 * b/c) +
  rnorm(length(x), sd=0.1)
d <- cbind(x,y)

ans <- f.quad.plateau(d, start=list(a = 7, b = 0.02, c = 1e-5),
  plus_minus=10, n.start=10, msg=FALSE)

boot.resid.quad.plateau(ans, d, x.range=seq(0,280,by=40),
  B=1e1-1, plus_minus = 1e2, n.start=1000, print.progress=TRUE) # use larger B for inference
```

compare.two.sample	<i>Two sample bootstrap test for comparing different in sample1 and sample2, not necessary with same sample size</i>
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Description

Two sample bootstrap test for comparing different in sample1 and sample2, not necessary with same sample size

Usage

```
compare.two.sample(sample1, sample2, fun = mean, R = 1000)
```

Arguments

sample1	first sample
sample2	second sample
fun	statistic (univariate) to be compared (default: mean)
R	number of resamples (default: 1000)

Value

compare.two.sample return a list with two components, namely, p.value: two tailed p-value for the bootstrap test object: a "simpleboot" object allowing further analysis using other R packages, such as boot)

Examples

```
set.seed(1203)
# compare median of two exponential r.v.
compare.two.sample(rexp(100, rate=1), rexp(100, rate=2), fun=median, R=1e3)$p.value

f.Q1 <- function(x) quantile(x, probs=0.25)
compare.two.sample(rnorm(100, mean=0), rnorm(200, mean=0.5), fun=f.Q1, R=1e3)$p.value
```

f.linear.plateau *Fitting linear plateau model using multiple initial values*

Description

f.linear.plateau fits linear plateau model using multiple initial values. The multiple initial values are randomly sampled in a "cube" of parameter space. More precisely, linear plateau model assumes $y \sim a + b * (x - c) * (x \leq c)$.

Usage

```
f.linear.plateau(
  d,
  start = list(a = 1, b = 1, c = 1),
  plus_minus = 100,
  n.start = 1000,
  msg = FALSE
)
```

Arguments

d	data frame with two columns (x and y)
start	initial estimate for non-linear least square (default value: <code>list(a = 1, b = 1, c = 1)</code>)
plus_minus	radius of random initial values (default: 100)
n.start	total number of initial points considered (default: 1000)
msg	logical flag whether printing progress

Value

`f.linear.plateau` returns a list of two components (if converged): `nls.summary`: summary of the fitted model; `nls.model`: nls object

Examples

```
set.seed(4)
x <- rep(1:300, each=4)
a <- 8; b <- 0.05; c <- 100
y <- a + b * (x - c) * (x <= c) +
  rnorm(length(x), sd=0.1)
d <- cbind(x,y)

# a converged example:
ans <- f.linear.plateau(d, start=list(a = 7, b = 0.1, c = 150),
  plus_minus=10, n.start=10, msg=FALSE)

summary(ans$nls.model)
```

f.quad

Fitting quadratic model using multiple initial values

Description

`f.quad` fits quadratic model using multiple initial values. The multiple initial values are randomly sampled in a "cube" of parameter space. More precisely, quadratic model assumes $y \sim a + b * x + c * x^2$,

Usage

```
f.quad(
  d,
  start = list(a = 1, b = 1, c = 1),
  plus_minus = 1,
```



```

    n.start = 10,
    msg = FALSE
  )

```

Arguments

d	data frame with two columns (x and y)
start	initial estimate for non-linear least square (default value: list(a = 1, b = 1, c = 1))
plus_minus	radius of random initial values (default: 100)
n.start	total number of initial points considered (default: 1000)
msg	logical flag whether printing progress

Value

f.quad returns a list of two components (if converged): nls.summary: summary of the fitted model;
nls.model: nls object

Examples

```

set.seed(1)
x <- rep(1:300, each=2)
a <- 8; b <- 0.05; c <- -1e-3
y <- a + b*x + c*x^2 + rnorm(length(x), sd=0.1)
d <- cbind(x,y)

# a converged example:
ans <- f.quad(d, start=list(a = 7, b = 0.02, c = 1e-5),
             plus_minus=10, n.start=10, msg=FALSE)

summary(ans$nls.model)

```

f.quad.plateau

Fitting quadratic plateau model using multiple initial values

Description

f.quad.plateau fits quadratic plateau model using multiple initial values. The multiple initial values are randomly sampled in a "cube" of parameter space. More precisely, quadratic plateau model assumes $y \sim (a + b * x + c * x^2) * (x \leq -0.5 * b/c) + (a + -b^2/(4 * c)) * (x > -0.5 * b/c)$.

Usage

```
f.quad.plateau(
  d,
  start = list(a = 1, b = 1, c = 1),
  plus_minus = 100,
  n.start = 1000,
  msg = FALSE
)
```

Arguments

<code>d</code>	data frame with two columns (x and y)
<code>start</code>	initial estimate for non-linear least square (default value: <code>list(a = 1, b = 1, c = 1)</code>)
<code>plus_minus</code>	radius of random initial values (default: 100)
<code>n.start</code>	total number of initial points considered (default: 1000)
<code>msg</code>	logical flag whether printing progress

Value

`f.quad.plateau` returns a list of two components (if converged): `nls.summary`: summary of the fitted model; `nls.model`: nls object

Examples

```
set.seed(3)
x <- rep(1:300, each=4)
a <- 8; b <- 0.05; c <- -1e-4
y <- (a + b * x + c * x^2) * (x <= -0.5*b/c) + (a + -b^2/(4 * c)) * (x > -0.5 * b/c) +
  rnorm(length(x), sd=0.1)
d <- cbind(x,y)

# a converged example:
ans <- f.quad.plateau(d, start=list(a = 7, b = 0.02, c = 1e-5),
  plus_minus=10, n.start=10, msg=FALSE)

summary(ans$nls.model)
```

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