Package ‘optDesignSlopeInt’

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Type Package

Title Optimal Designs for Estimating the Slope Divided by the Intercept

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Description Aids practitioners to optimally design experiments that measure the slope divided by the intercept and provides confidence intervals for the ratio.

Encoding UTF-8

License GPL-3

Depends R (>= 4.0.0)

Imports stats, graphics, MCMCpack

RoxygenNote 7.2.3

NeedsCompilation no

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design_bakeoff	*A visualiation for comparing slope-divided-by-intercept estimates for a number of designs*

Description

A visualiation for comparing slope-divided-by-intercept estimates for a number of designs

Usage

```
design_bakeoff(
  xmin,
  xmax,
  designs,
  gen_resp = function(xs) {
     1 + 2 * xs + rnorm(length(xs), 0, 1)
 },
  Nsim = 1000,
  l_quantile_display = 0.01,
  u_quantile_display = 0.99,
  error_est = function(est) {
     quantile(est, 0.99) - quantile(est, 0.01)
 },
  num_digits_round = 3,
  draw_theta_at = NULL,
  xlab_names = NULL,
  ...
)
```

Arguments

xmin	The minimum value of the independent variable.
xmax	The maximum value of the independent variable.
designs	A d x n matrix where each of the d rows is a design (the x values used to run the experiment).
gen_resp	A model for the response which takes the design as its parameter.
Nsim	The number of estimates per design. Default is `1000`.
l_quantile_display	The lowest quantile of the simulation estimates displayed. Default is `0.025`.
u_quantile_display	The highest quantile of the simulation estimates displayed. Default is `0.975`.
error_est	The error metric for the estimates. The sample standard deviation (i.e. `sd`) is unstable at low sample sizes. The default is the 90 percentile minus the 10 percentile.

num_digits_round
: The number of digits to round the error results. Default is 2.

draw_theta_at
: If the user wishes to draw a horizontal line marking theta (to checked biasedness) it is specified here. The default is `NULL` with no line being drawn.

xlab_names
: Text for the x-grid labels. This vector's size should equal `lenth(designs)`.

...
: Additional arguments passed to the `boxplot` function.

Value

A list with the simulated estimates and error estimates for each design.

Author(s)

Adam Kapelner

Examples

```
xmin = 5 / 15
xmax = 19 / 1
n = 10 #must be even for this demo
designs = rbind(
  c(rep(xmin, n / 2), rep(xmax, n / 2)),       #design A
  seq(from = xmin, to = xmax, length.out = n)  #design B
)
design_bakeoff_info = design_bakeoff(xmin, xmax, designs) #design A wins
```

---

err_vs_theta0_plot_for_homo_design

Plots a standard error estimate of thetahat (slope over intercept) over a range of possible theta0 values in order to investigate robustness of the the initial theta0 guess.

Description

Plots a standard error estimate of thetahat (slope over intercept) over a range of possible theta0 values in order to investigate robustness of the the initial theta0 guess.

Usage

```
err_vs_theta0_plot_for_homo_design(
  n,
  xmin,
  xmax,
  theta,
  theta0_min,
  theta0_max,
  theta0 = NULL,
```

```
  beta0 = 1,
  sigma = 1,
  RES = 500,
  Nsim = 5000,
  error_est = function(est) {
     quantile(est, 0.99) - quantile(est, 0.01)
 },
  theta_logged = TRUE,
  error_pct = TRUE,
  plot_rhos = FALSE,
  ...
)
```

Arguments

n	The number of experimental runs.
xmin	The minimum value of the independent variable.
xmax	The maximum value of the independent variable.
theta	The putative true value. This is used to see how much efficiency given up by designing it for `theta0`.
theta0_min	Simulating over different guesses of theta0, this is the minimum guess.
theta0_max	Simulating over different guesses of theta0, this is the maximum guess.
theta0	The guess used to construct the experimental design. Specify only if you wish to see this value plotted. Default is `NULL`.
beta0	A guess to be used for the intercept. Defaults to `1`.
sigma	A guess to be used for the homoskedastic variance of the measurement errors. If known accurately, then the standard errors (i.e. the y-axis on the plot) will be accurate. Otherwise, the standard errors are useful only when compared to each other in a relative sense. Defaults to `1`.
RES	The number of points on the x-axis to simulate. Higher numbers will give smoother results. Default is `20`.
Nsim	The number of models to be simulated for estimating the standard error at each value on the x-axis. Default is `1000`.
error_est	The error metric for the estimates. The sample standard deviation (i.e. `sd`) is unstable at low sample sizes. The default is the 90 percentile minus the 10 percentile.
theta_logged	Should the values of theta be logged? Default is `TRUE`.
error_pct	Plot error as a percentage increase from minimum. Default is `TRUE`.
plot_rhos	Plot an additional graph of rho by theta0. Default is `FALSE`.
...	Additional arguments passed to the `plot` function.

Value

A list with original parameters as well as data from the simulation

Author(s)

Adam Kapelner

Examples

```
xmin = 5 / 15
xmax = 19 / 1
n = 10
theta0 = 0.053
plot_info = err_vs_theta0_plot_for_homo_design(
  n, xmin, xmax, theta0, theta0_min = 0.001, theta0_max = 1
)
```

---

experimental_results *Report the results of the experiment as well as confidence intervals.*

Description

Report the results of the experiment as well as confidence intervals.

Usage

```
experimental_results(xs, ys, alpha = 0.05, B = 1000)
```

Arguments

xs	The design
ys	The measurements of the response
alpha	1 - alpha is the confidence of the computed intervals. Default is 0.05.
B	For the confidence interval methods with an embedded bootstrap (or resampling), the number of resamples (defaults to 1000).

Value

A list object containing the estimate as well as confidence intervals and parameters.

Author(s)

Adam Kapelner

Examples

```
n = 10
xmin = 5 / 15
xmax = 19 / 1
xs = runif(n, xmin, xmax)
ys = 2 + 3 * xs + rnorm(n)
experimental_results_info = experimental_results(xs, ys)
```

napth *This is data for the PRV measurement of the k_H of Napthalene in water. See Section 3 of our paper below for more information.*

Description

This is data for the PRV measurement of the k_H of Napthalene in water. See Section 3 of our paper below for more information.

Usage

```
data(napth)
```

Format

A data frame with 100 rows and 2 variables

Author(s)

Adam Kapelner <kapelner@qc.cuny.edu>

References

https://arxiv.org/abs/1604.03480

oed_for_slope_over_intercept *Create an optimal design for measuring the slope divided by the intercept*

Description

Create an optimal design for measuring the slope divided by the intercept

Usage

```
oed_for_slope_over_intercept(
  n,
  xmin,
  xmax,
  theta0,
  f_hetero = NULL,
  MaxIter = 6000,
  MaxFunEvals = 6000,
  TolFun = 1e-06,
  NUM_RAND_STARTS = 50
)
```

Arguments

- `n` — The number of experimental runs.
- `xmin` — The minimum value of the independent variable.
- `xmax` — The maximum value of the independent variable.
- `theta0` — The guess of the true value of the slope / intercept.
- `f_hetero` — Specification of heteroskedasticity: the h(x) which relates the value of the independent variable to the variance in the response around the line at that place or the proportional variance at that point. If `NULL`, homoskedasticity is assumed (this is the default behavior).
- `MaxIter` — For the heteroskedastic design, a Nelder-Mead search is used (via the function `fminbnd`). This is the `MaxIter` value for the search. Default is `6000`. Lower if `n` is high.
- `MaxFunEvals` — For the heteroskedastic design, a Nelder-Mead search is used (via the function `fminbnd`). This is the `MaxFunEvals` value for the search. Default is `6000`. Lower if `n` is high.
- `TolFun` — For the heteroskedastic design, a Nelder-Mead search is used (via the function `fminbnd`). This is the `TolFun` value for the search. Default is `1e-6`. Increase for faster execution.
- `NUM_RAND_STARTS` — For the heteroskedastic design, a Nelder-Mead search is used (via the function `fminbnd`). The Nelder-Mead search must be given a starting location. Our implementation uses many starting locations. This parameter controls the number of additional random starting locations in the space `[xmin, xmax]`. Default is `50`.

Value

An n-vector of x-values which specifies the optimal design

Author(s)

Adam Kapelner

Examples

```
xmin = 5 / 15
xmax = 19 / 1
n = 10
theta0 = 0.053
opt_homo_design = oed_for_slope_over_intercept(n, xmin, xmax, theta0)
table(opt_homo_design)
```

optDesignSlopeInt *Optimal Designs for Estimating the Slope Divided by the Intercept*

Description

Software which helps practitioners optimally design experiments that measure the slope divided by the intercept.

Author(s)

Adam Kapelner <kapelner@qc.cuny.edu>

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