Package 'VDSPCalibration'

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Type Package

Title Statistical Methods for Designing and Analyzing a Calibration Study

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Description Provides statistical methods for the design and analysis of a calibration study, which aims for calibrating measurements using two different methods. The package includes sample size calculation, sample selection, regression analysis with error-in measurements and change-point regression. The method is described in Tian, Durazo-Arvizu, Myers, et al. (2014) <DOI:10.1002/sim.6235>.

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VDSPCalibration-package

Statistical Methods for Designing and Analyzing a Calibration Study

Description

Implements statistical methods for designing and analyzing a calibration study

Details

Implements statistical methods for design and analysis of a calibration study. The important functions are "samplesize": for sample size estimation; "sampletot": for sample selection, "calfun": for estimating calibrating equation and "chngpt": for estimating the piece-wise linear equation.

Author(s)

Ramon Durazo-Arvizu, Chris Sempos, and Lu Tian

References

Tian L., Durazo-Arvizu R. A., Myers G., Brooks S., Sarafin K., and Sempos C. T. (2014), The estimation of calibration equations for variables with heteroscedastic measurement errors, Statist. Med., 33, pages 4420-4436

calfun

Estimating the Calibration Equation

Description

Estimates the calibration equation based on CV information

Usage

```
calfun(x, y, CVx, CVy = CVx, lambda0 = 1)
```

Arguments

x	old VD measurements
y	reference (new) VD measurements
CVx	CV% of the old VD measurements
CVy	CV% of the new VD measurements
lambda0	the CV ratio of the new vs old measurements

Details

Estimation of the calibration equation. It covers 4 scenarios: Only CVx is known; only CVy is known; both CVx and CVy are known; and Only the ratio of CVy to CVx is known.

Value

`coef`	estimated coefficients of the linear function
`se`	standard errors of the estimated coefficients
`lower CI`	the lower end of the 95% CI of the regression coefficients
`upper CI`	the upper end of the 95% CI of the regression coefficients

Author(s)

Durazo-Arvizu, Ramon; Sempos, Chris; Tian, Lu

References

Tian L., Durazo-Arvizu R. A., Myers G., Brooks S., Sarafin K., and Sempos C. T. (2014), The estimation of calibration equations for variables with heteroscedastic measurement errors, Statist. Med., 33, pages 4420-4436

Examples

```
n=100
sigma0=10

beta0=5
beta1=1.2
CVx=0.15
CVy=0.07

lambda0=CVy^2/CVx^2

x0=runif(n, 20, 200)
y0=beta0+beta1*x0+rnorm(n)*sigma0
x=x0+x0*CVx*rnorm(n)
y=y0+y0*CVy*rnorm(n)

fit=calfun(x, y, CVx, CVy, lambda0)
fit
```

chngpt *Piecewise Regression Estimation*

Description

Estimate a piecewise linear regression equation

Usage

```
chngpt(x, y, start = quantile(x, probs = 0.1,

na.rm = "TRUE"),finish = quantile(x, probs = 0.9, na.rm = "TRUE"),

NbrSteps = 500)
```

Arguments

x	old VD measurements
y	reference (new) VD measurements
start	lower bound of the changing point
finish	upper bound of the changing point
NbrSteps	number of points used in grid search

Details

This function uses grid search method to fit a piecewise linear regression model with one changing point

Value

x	old VD levels
y	new VD levels
yfitted	calibrated VD levels based on the fitted piecewise linear regression
chngpt	the estimated chang point
coefficients	the estimated regression coefficients for the piecewise linear regression

Author(s)

Durazo-Arvizu, Ramon and Sempos, Chris

References

Tian L., Durazo-Arvizu R. A., Myers G., Brooks S., Sarafin K., and Sempos C. T. (2014), The estimation of calibration equations for variables with heteroscedastic measurement errors, Statist. Med., 33, pages 4420-4436

Examples

```
### Generate equally spaced TEST VALUES in the interval [20,200]
set.seed(123456789)
x= 20 + 180*1:100/100
x2= (x - 95)*(x>=95)

# Generate REFERENCE VALUES
y = -8 + 1.5*x - 0.85*x2 + 15*rnorm(100)

#Plot test values versus reference values along with fitted piecewise model
plot(x,y)
fit.chngpt = chngpt(x,y)
plot(fit.chngpt$x[order(fit.chngpt$yfitted)],
     fit.chngpt$y[order(fit.chngpt$yfitted)],
     xlim=c(0,200), ylim=c(0,200), xlab="25-Hydroxyvitamin D (nmol/mL), IDS",
     ylab="25-Hydroxyvitamin D (nmol/mL), LC/MS", bty="n", las=1)
lines(fit.chngpt$x[order(fit.chngpt$yfitted)],
      fit.chngpt$yfitted[order(fit.chngpt$yfitted)], lty=2,col=2, lwd=2)
abline(v=fit.chngpt$chngpt, lty=2,col=3, lwd=2)
arrows(fit.chngpt$chngpt+20 ,15, fit.chngpt$chngpt,-8, length=0.1, lwd=2, col=4)
legend(fit.chngpt$chngpt + 5,30, legend=round(fit.chngpt$chngpt, digits=1),
       bty="n", col=4)
```

`samplefun` *Uniformly Sampling*

Description

Draws samples uniformly (for internal use only)

Usage

```
samplefun(x, index, n0)
```

Arguments

`x`	The VD values
`index`	the index for VD value, it can be 1, 2, 3,....
`n0`	Sample size

Details

Uniform sampling (internal use only)

Value

index	selected ids
x	selected VD levels

Author(s)

Durazo-Arvizu, Ramon, Sempos, Chris and Tian, Lu

See Also

sampletot

Examples

```
x=rnorm(100)
index=1:100
samplefun(x, index, 40)
```

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samplesize *Uniform Sampling Within Quartiles*

Description

Estimates the sample size to achived the specified precision in the estimated calibration equation.

Usage

```
samplesize(x0, d0, cutpts = c(7.5, 42.5, 57.5, 72.5, 200), CVx, CVy)
```

Arguments

x0	The value at which calibration will be esitmated (e.g., 30 nmol/L)
d0	Targeted width of the 95% confidence interval of the calibrated value (e.g. 5nmol/L)
cutpts	Cut points used to define intervals, within which samples would be selected uniformly
CVx	CV% of the old method (e.g. 12%)
CVy	CV% of the reference (new) method (e.g. 5%)

Details

The function estimates the sample size to achived the specified precision in the estimated calibration equation. The precision is defined via x0 and d0

Value

Required sample size to achived the specified precision in the estimated calibration equation.

Author(s)

Durazo-Arvizu, Ramon, Sempos, Chris and Tian, Lu

References

Tian L., Durazo-Arvizu R. A., Myers G., Brooks S., Sarafin K., and Sempos C. T. (2014), The estimation of calibration equations for variables with heteroscedastic measurement errors, Statist. Med., 33, pages 4420-4436

Examples

```
samplesize(30, 5, cutpts=c(7,42,57,72,200),0.12, 0.05)
```

`sampletot` *Samples Selection*

Description

Selects samples used in a calibration study

Usage

```
sampletot(x, index, n0, K)
```

Arguments

`x`	the old sample measurements needing calibration
`index`	the ID list of the old sample measurements needing calibration
`n0`	the required sample size
`K`	the number of quantiles, it is 4 if we use quartiles (recommended)

Details

The function selectes samples used in the calibration study

Value

`x`	the selected sample measurements to be used in the calibration study
`index`	the id list of the selected samples to be used in the calibration study

Author(s)

Durazo-Arvizu, Ramon, Sempos, Chris and Tian, Lu

References

Tian L., Durazo-Arvizu R. A., Myers G., Brooks S., Sarafin K., and Sempos C. T. (2014), The estimation of calibration equations for variables with heteroscedastic measurement errors, Statist. Med., 33, pages 4420-4436

Examples

```
VD.value= 60 + 25*rnorm(1000)
VD.index=1:1000

### x:     the VD value
### index: the index for VD value, it can be 1, 2, 3,....
### n0:    the number of samples we want to select
### K:     the number of quantiles, it is 4 if we use quartiles

sampletot(x=VD.value, index=VD.index, n0=100, K=4)
```

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