

# 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](https://doi.org/10.1002/sim.6235)>.

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 VDSPCalibration-package

*Statistical Methods for Designing and Analyzing a Calibration Study*


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### 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

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 calfun

*Estimating the Calibration Equation*


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### 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 CV<sub>x</sub> is known; only CV<sub>y</sub> is known; both CV<sub>x</sub> and CV<sub>y</sub> are known; and Only the ratio of CV<sub>y</sub> to CV<sub>x</sub> 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
```

chngp

*Piecewise Regression Estimation***Description**

Estimate a piecewise linear regression equation

**Usage**

```
chngp(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
chngp	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*

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**Description**

Estimates the sample size to achieved 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 achieved the specified precision in the estimated calibration equation. The precision is defined via x0 and d0

**Value**

Required sample size to achieved 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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