

# Package ‘reldist’

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**Title** Relative Distribution Methods

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**Description** Tools for the comparison of distributions. This includes nonparametric estimation of the relative distribution PDF and CDF and numerical summaries as described in “Relative Distribution Methods in the Social Sciences” by Mark S. Handcock and Martina Morris, Springer-Verlag, 1999, Springer-Verlag, ISBN 0387987789.

**Imports** mgcv, densEstBayes

**Suggests** locfit

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`gini`*Compute the Gini Coefficient*

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**Description**

Computes the Gini coefficient based on (possibly weighted) sample data

**Usage**

```
gini(x, weights=rep(1,length=length(x)))
```

**Arguments**

<code>x</code>	a vector containing at least non-negative elements
<code>weights</code>	an optional vector of sample weights for <code>x</code>

**Details**

Gini is the Gini coefficient, a common measure of inequality within a distribution. It is commonly used to measure income inequality. It is defined as twice the area between the 45 degree line and a Lorenz curve, where the Lorenz curve is a graph describing the share of total income  $T$  accruing to the poorest fraction  $p$  of the population.

In typical use the values of `x` are the incomes of individuals from a survey and the `weights` are the corresponding survey weights. If the values of `x` are the mean incomes within income classes and the `weights` are the corresponding population proportions within those classes, the function computes an estimate of the Gini coefficient of the underlying income distribution.

**Value**

the Gini coefficient (between 0 and 1).

**Author(s)**

Mark S. Handcock <handcock@stat.ucla.edu>

**Source**

*Relative Distribution Methods in the Social Sciences*, by Mark S. Handcock and Martina Morris, Springer-Verlag, Inc., New York, 1999. ISBN 0387987789.

**References**

*Relative Distribution Methods in the Social Sciences*, by Mark S. Handcock and Martina Morris, Springer-Verlag, Inc., New York, 1999. ISBN 0387987789.

*Divergent Paths: Economic Mobility in the New American Labor Market*, Russell Sage Foundation, New York, June 2001 Annette D. Bernhardt, Martina Morris, Mark S. Handcock and Marc Scott.

*Measurement of Inequality*, by F. A. Cowell, in A. B. Atkinson / F. Bourguignon (Eds): Handbook of Income Distribution, Amsterdam, 2000.

*Measuring Inequality*, by F. A. Cowell, Prentice Hall/Harvester Wheatsheaf, 1995.

### See Also

[reldist](#), [nls](#)

### Examples

```
# generate vector (of incomes)
x <- c(541, 1463, 2445, 3438, 4437, 5401, 6392, 8304, 11904, 22261)
# compute Gini coefficient
gini(x)
# generate a vector of weights.
w <- runif(n=length(x))
gini(x,w)
#
# Compute the inequality in income growth for the recent cohort of the
# National Longitudinal Survey (NLS) initiated in 1979.
#
library(reldist)
data(nls)
help(nls)
# Compute the wage growth
y <- exp(recent$chpermwage)
# Compute the unweighted estimate
gini(y)
# Compute the weighted estimate
gini(y,w=recent$wgt)
```

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nls

*Permanent wage growth in two cohorts of the NLS*

---

### Description

These data are from two cohorts of the National Longitudinal Survey (NLS) initiated in 1966 and 1979. The cohorts are referred to as the ‘original’ and the ‘recent’ cohort, respectively. The data represents the permanent wage growth of each individual in the cohort from age 16 through 36. This was used in Handcock and Morris (1999) and Bernhardt, Morris, Handcock and Scott (2001) to study the question of wage mobility. A development of the estimation of these permanent wages and their relevance to the study of wage mobility is given in Handcock and Morris (1999). For the purposes of this `reldist` package, we can regard the permanent wages as measurements on two groups that we wish to compare.

The data set is comprised of two data.frames called ‘original’ and ‘recent’. Each has three columns: `chpermwage`: the change in permanent wages (in log-dollars), `endeduc`: the final achieved educational level (in years), and `wgt`: the sample weight.

**Usage**

```
data(nls)
```

**Source**

*Relative Distribution Methods in the Social Sciences*, by Mark S. Handcock and Martina Morris, Springer-Verlag, Inc., New York, 1999. ISBN 0387987789.

**References**

*Relative Distribution Methods in the Social Sciences*, by Mark S. Handcock and Martina Morris, Springer-Verlag, Inc., New York, 1999. ISBN 0387987789.

*Divergent Paths: Economic Mobility in the New American Labor Market*, Russell Sage Foundation, New York, June 2001 Annette D. Bernhardt, Martina Morris, Mark S. Handcock and Marc Scott.

**See Also**

reldist

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precipitation

*Annual Precipitation in US Cities*

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**Description**

The average amount of precipitation (rainfall) in inches for each of 70 United States (and Puerto Rico) cities.

**Usage**

```
data(precipitation)
```

**Format**

A named vector of length 70.

**Details**

This is a clone of the precip R dataset to avoid a bug in R.

**Source**

Statistical Abstracts of the United States, 1975.

**References**

McNeil, D. R. (1977) *Interactive Data Analysis*. New York: Wiley.

**Examples**

```
require(graphics)
data(precipitation)
dotchart(precipitation[order(precipitation)], main="precipitation data")
title(sub = "Average annual precipitation (in.)")
```

reldist

*Inference for Relative Distributions***Description**

Estimate and graph relative distribution and density functions for continuous or discrete data.

**Usage**

```
reldist(y, yo=FALSE, ywgt=FALSE, yowgt=FALSE,
  show="none", decomp="locadd",
  location="median", scale="IQR",
  rpmult=FALSE,
  z=FALSE, zo=FALSE,
  smooth = 0.35,
  quiet = TRUE,
  cdfplot=FALSE,
  ci=FALSE,
  bar="no",
  add=FALSE,
  graph=TRUE, type="l",
  xlab="Reference proportion", ylab="Relative Density", yaxs="r",
  yolabs=pretty(yo), yolabslabs=NULL,
  ylabs=pretty(y), ylabslabs=NULL,
  yolabsloc=0.6, ylabslloc=1,
  ylim=NULL, cex=0.8, lty=1,
  binn=5000,
  aicc=seq(0.0001, 5, length=30),
  deciles=(0:10)/10,
  discrete=FALSE,
  method="Bayes",
  y0=NULL,
  control = list(samples = 4000, burnin = 1000),
  ...)
```

**Arguments**

y	Sample from comparison distribution.
yo	Sample from reference distribution.
discrete	Do y and yo refer to a discrete distribution? If TRUE a discrete estimator is used instead of the default continuous one.

smooth	Degree of smoothness required in the fit. Higher values lead to smoother curves, lower positive values lead to closer fits to the observed data. If it is not specified the value that minimizes GCV is used. If a value less than zero is specified then the value is chosen to minimize a corrected AIC. If <code>discrete=TRUE</code> it is the minimum number of values to pool in the reference distribution in the probability mass function estimate.
method	Method used to estimate the relative density. The default ("Bayes") uses a density estimator based on Poisson Nonparametric Regression and Bayesian inference developed by Wand and Wu (2022). The option ("bgk") uses a Gaussian kernel density estimator for bounded domain one-dimensional data developed by Botev, Grotowski and Kroese (2010). The option ("gam") uses a local likelihood approach based on smoothed Poisson regression. The option "loclik" uses log-splines. The option "quick" uses the Anscombe transformation to stabilize variances. In versions prior to 1.3 the "quick" approach was used.
graph	Graph the results on the current device.
bar	Graph the deciles on the current device. Possible values of bar are "no" (no deciles plotted), "yes" (deciles plotted with the non-parametric fit, "only"(deciles plotted without non-parametric fit).
add	Add the density to the current plot?
ylim	plotting limit for the vertical axis.
lty	Line type to be used for the density.
xlab	Horizontal label.
ylab	Vertical label.
ylabs	Locations for label to be added to the right axis.
ylabslabs	Labels indicating the original scale for the comparison distribution.
ylabsloc	Distance of labels to right of axis (in lines).
yolabs	locations for labels to be added to the tip axis.
yolabslabs	Labels indicating the original scale for the reference distribution.
yolabsloc	Distance of labels above axis (in lines).
yaxs	Style of vertical axis.
cdfplot	calculate and plot the CDF rather than the density.
quiet	Should the output be returned invisibly?
ci	Plot (pointwise) 95% confidence intervals?
ywgt	Weights on the comparison sample.
yowgt	Weights on the reference sample.
z	Covariate on the comparison sample to be used to adjust it to the reference distribution. Only used if the form of matching specified in <code>decomp="covariate"</code> .
zo	Covariate on the reference sample to be used in the adjustment. to the reference distribution. Only used if the form of matching specified in <code>decomp="covariate"</code> .

show	Type of relative distribution to produce. Possible values are "none" (comparisons to reference), residual (location-matched reference to reference), effect (comparison to location-matched reference).
decomp	Form of matching to the comparison sample. Possible values are locmult (multiplicatively scale the reference), locadd (additively shift the reference), lsadd (location/scale additive shift), covariate (covariate adjust the reference (requires z and zo to be specified)).
location	How to measure location. Possible values are "mean" and "median".
scale	How to measure the scale. Possible values are "standev" (standard deviation) and IQR (interquartile range).
rpmult	Only in calculation of polarization indices: multiplicatively scale the reference sample to the comparison sample before comparing the two distributions?
bin	Number of bins used in the smoother.
deciles	The percentiles used for the histogram bins. Typically deciles (i.e., 0.0, 0.1, 0.2, ..., 0.9, 1.0), but any set can be used (e.g., quintiles, terciles).
aicc	Values of the smoothing parameter to search over in minimizing the corrected AIC. Only used if method="gam" and smooth is less than 0.
type	Type of plot to use. See par().
cex	Character expansion to use in plots. See par().
y0	A test to see if yo was passed. If y0 is passed it prints a warning. If y0 is passed and yo is not passed then y0 is used as the sample from reference distribution.
control	list; A simple list of control options for the STAN HMC computation used when method="Bayes", the default. The two components are samples=4000, the number of samples drawn and burnin=1000, the burn-in used.
...	Additional arguments to the plot functions. See par().

**Value**

x	Horizontal coordinates for the density (typically percentages).
y	Density at x.
rp	95% confidence interval for the median relative polarization as lower bound, estimate, upper bound.
rp1	95% confidence interval for the lower relative polarization as lower bound, estimate, upper bound.
rpu	95% confidence interval for the upper relative polarization as lower bound, estimate, upper bound.
cdf	x coordinates for the CDF (typically percentages) and y CDF at x.

**Note**

Most of the code is for the plotting and tinkering. The guts of the method are forming the relative data at the top. The rest is a standard fixed interval density estimation with a few bells and whistles.

## References

For more examples see the tech report

Mark S. Handcock and Eric Mark Aldrich *Applying Relative Distribution Methods in R* University of Washington CSSS Working Paper No. 27, Available at SSRN: doi: [10.2139/ssrn.1515775](https://doi.org/10.2139/ssrn.1515775).

Z. I. Botev, J. F. Grotowski and D. P. Kroese *Kernel Density Estimation Via Diffusion* Annals of Statistics, 2010, Volume 38, Number 5, Pages 2916-2957.

M. Wand and J. C. F. Yu *Density Estimation via Bayesian Inference Engines* AStA Advances in Statistical Analysis, 2021, doi: [10.1007/s10182021004228](https://doi.org/10.1007/s10182021004228).

## Examples

```
#
# First load the data.
#

data(nls, package="reldist")

#
# A simple example comparing permanent wages of the original to the
# recent cohort in the NLS. See H&M (1999) for details.

reldist(y=recent$chpermwage, yo=original$chpermwage, method="bgk")

#
# A more sophisticated version of the same.
#

reldist(y=recent$chpermwage, yo=original$chpermwage,
        yowgt=original$wgt, ywgt=recent$wgt,
        bar=TRUE,
        smooth=0.1, method="bgk",
        yolabs=seq(-1, 3, by=0.5),
        ylim=c(0, 3.0), cex=0.8,
        ylab="Relative Density",
        xlab="Proportion of the Original Cohort")

#
# A CDF version.
#

reldist(y=recent$chpermwage, yo=original$chpermwage,
        yowgt=original$wgt, ywgt=recent$wgt,
        cdfplot=TRUE,
        smooth=0.4,
        yolabs=seq(-1, 3, by=0.5),
        ylabs=seq(-1, 3, by=0.5),
        cex=0.8,
        method="bgk",
        ylab="proportion of the recent cohort",
        xlab="proportion of the original cohort")
```



---

resplot	<i>Relative distribution plot to a Standard Normal</i>
---------	--

---

### Description

resplot produces a relative distribution of the values to a standard normal. Graphical parameters may be given as arguments to resplot.

### Usage

```
resplot(x,  
        standardize=TRUE,  
        xlab="Gaussian Cumulative Proportion",  
        method="Bayes",  
        ...)
```

### Arguments

x	The first sample for resplot.
standardize	Should the sample be converted to standard units first?
xlab	plot labels.
method	Method used to estimate the relative density. The default ("Bayes") uses a density estimator based on Poisson Nonparametric Regression and Bayesian inference developed by Wand and Wu (2022). The option ("bgk") uses a Gaussian kernel density estimator for bounded domain one-dimensional data developed by Botev, Grotowski and Kroese (2010). The option ("gam") uses a local likelihood approach based on smoothed Poisson regression. The option "loclik" uses log-splines. The option "quick" uses the Anscombe transformation to stabilize variances. In versions prior to 1.3 the "quick" approach was used.
...	graphical parameters.

### Value

A list with components summarizing the relative distribution. See `reldist` for the details.

### See Also

[reldist](#).

### Examples

```
y <- rnorm(2000)  
resplot(y, method="bgk")  
data(precipitation)  
resplot(precipitation, ylab = "Precipitation [in/yr] for 70 US cities", method="bgk")
```

---

wtd.iqr	<i>Weighted Interquartile range</i>
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---

**Description**

Compute weighted Interquartile range (iqr)

**Usage**

```
wtd.iqr (x, na.rm = FALSE, weight=NULL)
```

**Arguments**

x	Vector of data, same length as weight
na.rm	Logical: Should NAs be stripped before computation proceeds?
weight	Vector of weights. If NULL, the default, weights are not used.

**Details**

Uses a simple algorithm based on sorting.

**Value**

Returns an empirical interquartile range from a weighted sample.

---

wtd.quantile	<i>Weighted Quantiles</i>
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---

**Description**

Compute weighted quantile

**Usage**

```
wtd.quantile (x, q=0.5, na.rm = FALSE, weight=NULL)
```

**Arguments**

x	Vector of data, same length as weight
q	Quantile to compute
na.rm	Logical: Should NAs be stripped before computation proceeds?
weight	Vector of weights. If NULL, the default, weights are not used.

**Details**

Uses a simple algorithm based on sorting.

**Value**

Returns an empirical  $q$  quantile from a weighted sample.

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