Package ‘REBayes’

February 19, 2015

Title  Empirical Bayes Estimation and Inference in R

Description  Kiefer-Wolfowitz maximum likelihood estimation for mixtures models
and some other density estimation and regression methods based on convex optimization.

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Depends  R (>= 2.10), Rmosek,Matrix,SparseM

Suggests  reliaR

SystemRequirements  MOSEK (http://www.mosek.com) and MOSEK License for
use of Rmosek.

License  GPL (>= 2)

URL  http://www.r-project.org

NeedsCompilation  no

Repository  CRAN

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Description

U.S. Major League Batting Average Data: 2002-2012

Usage

data(bball)

Format

A data frame with 10575 longitudinal observations on the following 8 variables.

name  name of player
id    numeric (unique) identifier of the player
year  year played, see details
season season played, see details
pitcher  indicator: 1 if pitcher
HA    transformed batting averages, see details
AB    at bats
H     hits

Details

Data is aggregated into half seasons: so season indicates whether the observation is in the first or second half of the season of a given year. Only players who have more than 10 at bats in any half season are included, and only players who have more than three half seasons are represented. The transformed batting average is arcsin(sqrt((H + 1/4)/(AB + 1/2))). R programs to extract the data from the original sources are available on request.

Source

ESPN Website: http://espn.go.com/mlb/statistics
Bmix

Examples
data(bball)

Bmix

Binomial mixture estimation via Kiefer Wolfowitz MLE

Description
Binomial mixture estimation via Kiefer Wolfowitz MLE

Usage
Bmix(x, k, v, m = 300, eps = 1e-06, rtol = 1e-09, collapse = TRUE,
       verb = 0, control = NULL)

Arguments

<table>
<thead>
<tr>
<th>Argument</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>x</td>
<td>count of &quot;successes&quot; for binomial observations</td>
</tr>
<tr>
<td>k</td>
<td>number of trials for binomial observations</td>
</tr>
<tr>
<td>v</td>
<td>Undata: Grid Values for the mixing distribution defaults to equal spacing of length m on [eps, 1-eps].</td>
</tr>
<tr>
<td>m</td>
<td>Number of equally spaced grid points desired.</td>
</tr>
<tr>
<td>eps</td>
<td>Tolerance parameter to determine support of grid.</td>
</tr>
<tr>
<td>rtol</td>
<td>Convergence tolerance for duality gap in Mosek.</td>
</tr>
<tr>
<td>collapse</td>
<td>Collapse observations into cell counts.</td>
</tr>
<tr>
<td>verb</td>
<td>Integer determining verbosity of Mosek output</td>
</tr>
<tr>
<td>control</td>
<td>Mosek control list see KWDual documentation</td>
</tr>
</tbody>
</table>

Details
Interior point solution of Kiefer-Wolfowitz NPMLE for mixture of binomials

Value
An object of class density with components:

<table>
<thead>
<tr>
<th>Argument</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>x</td>
<td>points of evaluation of the mixing density</td>
</tr>
<tr>
<td>y</td>
<td>function values of the mixing density at x</td>
</tr>
<tr>
<td>logLik</td>
<td>Log Likelihood value at the estimate</td>
</tr>
<tr>
<td>flag</td>
<td>exit code from the optimizer</td>
</tr>
</tbody>
</table>

Author(s)
R. Koenker
References


flies

Medfly Data

Description

Medfly data from the Carey et al (1992) experiment. 1,203,646 uncensored survival times!

Usage

data(flies)

Format

A data frame with 19072 observations on the following 17 variables.

age  age at death in days
num  frequency count of age at death
prcurr  current proportion male
current  current density
cohort  cohort/pupal batch
size  pupal size
cage  cage number
female  female = 1
cumul  cumulative density
prcumu  cumulative proportion male
begin  initial cage density
prbegin  initial proportion male
size4  size group 4
size5  size group 5
size6  size group 6
size7  size group 7
size8  size group 8

Details

Quoting from Carey et al (1992) “...Pupae were sorted into one of five size classes using a pupal sorter. This enabled size dimorphism to be eliminated as a potential source of sex-specific mortality differences. Approximately, 7,200 medflies (both sexes) of a given size class were maintained in each of 167 mesh covered, 15 cm by 60 cm by 90 cm aluminum cages. Adults were given a diet of sugar and water, ad libitum, and each day dead flies were removed, counted and their sex determined.”
References


Examples

data(flies)

---

### GLmix

**MLE (Kiefer-Wolfowitz) Density Estimation**

Description

Density estimation based on Kiefer Wolfowitz method

Usage

```r
GLmix(x, v, m = 300, sigma = 1, eps = 1e-06, hist = FALSE,
      rtol = 1.0e-6, verb = 0, control = NULL)
```

## S3 method for class 'GLmix'
predict(object, newdata, Loss = 2, ...)

Arguments

- `x`: Data: Sample Observations
- `v`: Undata: Grid Values defaults equal spacing of length m
- `m`: Number of (default) grid points
- `sigma`: scale parameter of the Gaussian noise
- `eps`: tolerance parameter
- `hist`: If TRUE then aggregate x to histogram weights
- `rtol`: relative tolerance for dual gap convergence criterion
- `verb`: integer determining how verbose the output should be
- `control`: Mosek control list see KWDual documentation
- `object`: fitted object of class "GLmix"
- `newdata`: Values at which prediction is desired
- `Loss`: Loss function used to generate prediction
- `...`: Other arguments for predict function
Details

Kiefer Wolowitz MLE density estimation as proposed by Jiang and Zhang for the Gaussian compound decision problem. The histogram option is intended for large problems, say \( n > 1000 \), where reducing the sample size dimension is desirable. When \( \sigma \) is heterogeneous and \( \text{hist} = \text{TRUE} \) the procedure tries to do separate histogram binning for distinct values of \( \sigma \); however this is only feasible when there are only a small number of distinct \( \sigma \). By default the grid for the binning is equally spaced on the support of the data. This function does the normal convolution problem, for gamma mixtures of variances see \texttt{gvmix} or for mixtures of both means and variances \texttt{TLVmix}. The optimization is carried out by calls to the function \texttt{mosek} in the required package \texttt{Rmosek}.

The predict method for \texttt{GLmix} objects will compute means, medians or modes of the posterior according to whether the \texttt{loss} argument is 2, 1 or 0.

Value

An object of class density with components

- \( x \) points of evaluation on the domain of the density
- \( y \) estimated function values at the points \( v \), the mixing density
- \( g \) the estimated mixture density returned via \texttt{approxfun}
- \( dy \) prediction of mean parameters for each observed \( x \) value via Bayes Rule
- \( \logLik \) Log likelihood value at the proposed solution
- \( \text{flag} \) exit code from the optimizer

Author(s)

Roger Koenker

References


Description

Kiefer-Wolfowitz NPMLE for Gompertz Mixtures of scale parameter

Usage

\texttt{Gompertzmix(x, v, alpha, theta, m = 300, weight = rep(1, length(x)), eps = 1e-06, hist = FALSE, rtol = 1e-06, verb = 0, control = NULL)}
**Arguments**

- **x**: Survival times
- **v**: Grid values for mixing distribution
- **alpha**: Shape parameter for Gompertz distribution
- **theta**: Scale parameter for Gompertz Distribution
- **m**: Number of v grid points
- **weight**: Frequency (count) for survival times
- **eps**: Tolerance parameter
- **hist**: If TRUE aggregate to histogram counts
- **rtol**: Convergence tolerance for optimization
- **verb**: Verboseness of optimization
- **control**: Mosek control parameters see KWDual documentation

**Details**

Kiefer Wolfowitz NPMLE density estimation for Gompertz scale mixtures. The histogram option is intended for relatively large problems, say n > 1000, where reducing the sample size dimension is desirable. By default the grid for the binning is equally spaced on the support of the data. The optimization is carried out by calls to the function `mosek` in the required package `Rmosek`.

**Value**

An object of class density with components

- **x**: Points of evaluation on the domain of the density
- **y**: Estimated function values at the points x, the mixing density
- **logLik**: Log likelihood value at the proposed solution
- **flag**: Exit code from the optimizer

**Author(s)**

Roger Koenker and Jiaying Gu

**References**


**See Also**

Weibullmix
GVmix

GVmix: Generalized Maximum Likelihood for Empirical Bayes Estimation of Gamma Variances

Description

A Kiefer-Wolfowitz procedure for ML estimation of a Gaussian model with independent variance components with longitudinal data.

Usage

GVmix(y, id, v, pv = 300, eps = 1e-06, rtol = 1.0e-6, verb = 0, control = NULL)

Arguments

y A vector of observations
id A strata indicator vector of the same length
v A vector of bin boundaries for the variance effects
pv The number of variance effect bins, if u is missing
eps A tolerance for determining the support of the bins
rtol relative tolerance for dual gap convergence criterion
verb A flag indicating how verbose the Mosek output should be
control Mosek control list see KWDual documentation

Details

See Gu and Koenker (2012?)

Value

An object of class density consisting of the following components:

x the variance bin boundaries
y the function values of the mixing density for the variances.
g the function values of the mixture density at the observed y’s.
logLik the value of the log likelihood at the solution
status the mosek convergence status.

Author(s)

R. Koenker

References

Gu Y. and R. Koenker (2013)
**KWDual**

Dual optimization for Kiefer-Wolfowitz problems

**Description**

Interface function for calls to Mosek from various REBayes functions

**Usage**

```
KWDual(x, w, d, A, rtol = 1e-6, verb = 0, control = NULL)
```

**Arguments**

- `x`: Observed data
- `w`: weights for `x`
- `d`: constraint vector
- `A`: Linear constraint matrix
- `rtol`: relative tolerance for dual gap convergence criterion
- `verb`: verbosity desired from mosek
- `control`: control list consisting of sublists `iparam`, `dparam`, and `sparam`, containing elements of various mosek control parameters. See the Rmosek and Mosek manuals for further details. A prime example is `rtol` which should eventually be deprecated and folded into `control`, but will persist for a while for compatibility reasons. Another example, the one that motivated the introduction of `control` would be `control = list(iparam = list(num_threads = 1))`, which forces Mosek to use a single threaded process. The default allows Mosek to uses multiple threads (cores) if available, which is generally desirable, but may have unintended consequences when running simulations on clusters.

**Details**

See userguide for Rmosek for further details.

**Value**

Returns a list with components:

- `f`: dual solution vector, the mixing density
- `g`: primal solution vector, the mixture density evaluated at the data points
- `logLik`: log likelihood
- `status`: return status from Mosek

**Author(s)**

R. Koenker
\textbf{L1norm} \hfill \textit{L1norm for piecewise linear functions}

\section*{Description}

Intended to compute the L1norm of the difference between two distribution functions.

\section*{Usage}

\begin{verbatim}
L1norm(F, G, eps = 1e-06)
\end{verbatim}

\section*{Arguments}

\begin{verbatim}
F \quad \text{A stepfunction}
G \quad \text{Another stepfunction}
eps \quad \text{A tolerance parameter}
\end{verbatim}

\section*{Details}

Both \(F\) and \(G\) should be of class \texttt{stepfun}, and they should be non-defective distribution functions. There are some tolerance issues in checking whether both functions are proper distribution functions at the extremes of their support. For simulations it may be prudent to wrap \texttt{L1norm} in \texttt{try}.

\section*{Value}

A real number.

\section*{Author(s)}

R. Koenker

\section*{Examples}

\begin{verbatim}
# Make a random step (distribution) function with Gaussian knots
rstep <- function(n){
  x <- sort(rnorm(n))
  y <- runif(n)
  y <- c(0,cumsum(y/sum(y)))
  stepfun(x,y)
}
F <- rstep(20)
G <- rstep(10)
S <- L1norm(F,G)
plot(F,main = paste("||F - G|| = ", round(S,4)))
lines(G,col = 2)
\end{verbatim}
Density estimation based on maximum entropy methods

Usage

```r
medde(x, v = 300, lambda, alpha = 1, Dorder = 1, rtol = 1e-06,
verb = 0, control = NULL)
qmedde(p, medde)
rmedde(n, medde, smooth = TRUE)
```

Arguments

- `x`: Data: either univariate or bivariate (not yet implemented in Rmosek)
- `v`: Undata: either univariate or bivariate, by default there is an equally spaced grid of 300 values
- `lambda`: total variation penalty parameter. if lambda is in [-1,0], a concavity constraint is imposed. If lambda is in (-oo,-1) a convexity constraint on .5 x^2 + log f is imposed. See Koenker and Mizera (2013) for further details on this last option, and Koenker and Mizera (2010) for further details on the concavity constrained options.
- `alpha`: Renyi entropy parameter characterizing fidelity criterion
- `Dorder`: Order of the derivative operator for the penalty
- `rtol`: Convergence tolerance for Mosek algorithm
- `verb`: Parameter controlling verbosity of solution, 0 for silent, 5 gives rather detailed iteration log.
- `control`: Mosek control list see KWDual documentation
- `n`: number of observations desired in calls to rmedde
- `p`: probabilities to evaluate in calls to qmedde
- `medde`: fitted medde object for calls in qmedde and rmedde
- `smooth`: option to draw random meddes from the smoothed density estimate, as described in Chen and Samworth (2013)

Details

See the references for further details. And also Mosek "Manuals". The acronym has a nice connection to


Term used in Bahamian dialect, mostly on the Family Islands like Eleuthera and Cat Island meaning "mess with" "get involved" "get entangled" "fool around" "bother"
"I don’t like to medder up with all kinda people"
"Don’t medder with people (chirren)"
"Why you think she medderin up in their business."

**Value**

An object of class "Medde" with components

- **x**: points of evaluation on the domain of the density
- **y**: estimated function values at the evaluation points x
- **phi**: n by 2 matrix of (sorted) original data and estimated log density values these data points
- **logLik**: log likelihood value
- **status**: exit status from Mosek

**Author(s)**

Roger Koenker

**References**


**See Also**

This function is based on an earlier function of the same name in the deprecated package MeddeR that was based on an R-Matlab interface.

**Examples**

```R
#Maximum Likelihood Estimation of a Log-Concave Density
set.seed(1968)
x <- rgamma(50,10)
m <- medde(x, v = 50, lambda = -.5, verb = 5)
plot(m)
```
Pmix

Poisson mixture estimation via Kiefer Wolfowitz MLE

Description

Poisson mixture estimation via Kiefer Wolfowitz MLE

Usage

Pmix(X, v, m = 300, eps = 1e-06, rtol = 1e-06, verb = 0, control = NULL)

Arguments

x Data: Sample observations (integer valued)

v Undata: Grid Values for the mixing distribution defaults to equal spacing of length m

m Number of default grid points

esps Tolerance parameter to determine support for grid

rtol Tolerance parameter for Mosek convergence

verb integer determining how verbose the Mosek output should be

control Mosek control list see KWDual documentation

Details

Kiefer Wolfowitz NPMLE estimation for Poisson mixtures.
Value

An object of class density with components:

- **x**: points of evaluation of the mixing density
- **y**: function values of the mixing density at x
- **g**: function values of the mixture density on 0, 1, ... \(\max(x)+1\), for computing Bayes rule
- **logLik**: Log Likelihood value at the estimate
- **flag**: exit code from the optimizer

Author(s)

Roger Koenker

References


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**rqss2**

*Quantile Regression L2 Penalized Smoothing Spline*

**Description**

Estimation of nonparametric conditional quantile functions using the classical (Wahba) L2 roughness penalty.

**Usage**

```r
rqss2(x, y, tau = 0.5, lambda = 1, dual = TRUE, rtol = 1e-06, verb = 0)
```

**Arguments**

- **x**: the design points
- **y**: the response values
- **tau**: the quantile of interest
- **lambda**: the penalty parameter
- **dual**: the computational method, dual if TRUE, primal otherwise
- **rtol**: tolerance for the solution
- **verb**: verbosity of the output, use verb = 5 for details of the solution iterations

**Details**

Calls the Mosek primal-dual interior point solver to compute solutions to the quadratic program defining the spline estimator.
Value

Returns the fitted values at the (ordered) design points.

Note

Only does bivariate scatterplot smoothing, see \texttt{rqss} in the \texttt{quantreg} package for more general additive modeling features.

Author(s)

Roger Koenker

References


See Also

\texttt{rqss}.

Examples

```r
# Test Problem (as usual) from Ruppert, Wand, and Carroll

n <- 50
x <- sort(runif(n))
g0 <- function(x, j = 4)
  sqrt(x *(1-x) * sin(2*pi*(1 + 2^((9-4*j)/5))/(x + 2^((9-4*j)/5)))
dgp <- function(x,f=rnorm,j=2,sigma=.2,gamma=0)
  f(length(x))*sigma*(1+gamma*x)
y <- g0(x) + dgp(x)
plot(x,y, cex = .5, col = "grey")
lines(x, g0(x))
fd <- rqss2(x,y, lambda = 0.0001)
if(fd$status == "OPTIMAL") lines(x, fd$fit, col = 2)
```

Description

This data was generated by Beckett and Diaconis (1994). They describe it as follows: "The example involves repeated rolls of a common thumbtack. A one was recorded if the tack landed point up and a zero was recorded if the tack landed point down. All tacks started point down. Each tack was flicked or hit with the fingers from where it last rested. A fixed tack was flicked 9 times. The data are recorded in Table 1. There are 320 9-tuples. These arose from 16 different tacks, 2 "flickers," and 10 surfaces. The tacks vary considerably in shape and in proportion of ones. The surfaces varied from rugs through tablecloths through bathroom floors." Following Liu (1996), we treat the data as though they came from 320 independent binomials. See \texttt{demo(Bmix1)} for further details.
Usage
data(tacks)

Format
A data frame with 320 observations on the following 2 variables.
x  a numeric vector giving the number of tacks landed point up.
k  a numeric vector giving the number of trials.

Source

References

tannenbaum Gaussian Mixture data

Description
Gaussian Location Mixture data to illustrate Mosek tolerance problem

Usage
data(tannenbaum)

Format
5000 iid Gaussians

Details
This data set was generated in the course of trying to understand some anomalies in estimating Gaussian location mixture problems with GLmix. It is used by the demo tannenbaum to illustrate that sometimes it is worthwhile reducing the convergence tolerance for mosek. See demo(tannenbaum) for further details.
Description

Density estimation based on Kiefer Wolfowitz method

Usage

```r
TLmix(x, v, u, df = 1, m = 300, eps = 1e-06,
hist = FALSE, rtol = 1.0e-6, verb = 0)
```

Arguments

- **x**: Data: Sample Observations
- **v**: Undata: Grid Values defaults equal spacing of length m
- **u**: Grid Values for histogram binning: defaults equal spacing of length m
- **df**: Number of degrees of freedom of Student base density
- **m**: Number of (default) grid points
- **eps**: tolerance parameter
- **hist**: If TRUE then aggregate x to histogram weights
- **rtol**: relative tolerance for dual gap convergence criterion
- **verb**: integer determining how verbose the output should be

Details

Kiefer Wolfowitz MLE density estimation as proposed by Jiang and Zhang for the Student t compound decision problem. The histogram option is intended for large problems, say n > 1000, where reducing the sample size dimension is desirable. By default the grid for the binning is equally spaced on the support of the data. This function does the Student deconvolution problem. The optimization is carried out by calls to the function `mosek` in the required package `Rmosek`.

Value

An object of class density with components

- **x**: points of evaluation on the domain of the density
- **y**: estimated function values at the points x, the mixing density
- **logLik**: Log likelihood value at the proposed solution
- **flag**: exit code from the optimizer

Author(s)

Roger Koenker
References


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**TLVmix**

*TLVmix: Maximum Likelihood for Empirical Bayes Estimation of Gaussian Means and Variances*

---

**Description**

A Kiefer-Wolfowitz procedure for ML estimation of a Gaussian model with independent mean and variance components with longitudinal data. This version employs Student t likelihood formulation.

**Usage**

```r
TLVmix(y, id, u, v, pu = 300, pv = 300, eps = 1e-06, rtol = 1e-06,
       verb = 0, control = NULL)
```

**Arguments**

- **y**: A vector of observations.
- **id**: A strata indicator vector of the same length.
- **u**: A vector of bin boundaries for the mean effects.
- **v**: A vector of bin boundaries for the variance effects.
- **pu**: The number of mean effect bins, if `u` is missing.
- **pv**: The number of variance effect bins, if `u` is missing.
- **eps**: A tolerance for determining the support of the bins.
- **rtol**: Relative tolerance for dual gap convergence criterion.
- **verb**: A flag indicating how verbose the Mosek output should be.
- **control**: Mosek control list see KWDual documentation.

**Details**

The vector `v` can be specified as a scalar; in this case no mixture distribution for variances is estimated, instead the variance distribution is set to be point mass one at the value specified by the scalar. This is (potentially) useful for inference about the need for a variance mixture. See Gu and Koenker (2013).
**Value**

A list consisting of the following components:

- `u`: the mean bin boundaries
- `fu`: the function values of the mixing density for the means
- `v`: the variance bin boundaries
- `fv`: the function values of the mixing density for the variances.
- `logLik`: log likelihood value for mean problem
- `status`: Mosek convergence status

**Author(s)**

R. Koenker

**References**


---

**Description**

Integration by Trapezoidal Rule

**Usage**

`traprule(x, y)`

**Arguments**

- `x`: points of evaluation
- `y`: function values

**Details**

Crude Riemann sum approximation.

**Value**

A real number.

**Author(s)**

R. Koenker
Weibullmix

NPMLE for Weibull Mixtures

Description

Kiefer-Wolfowitz NPMLE for Weibull Mixtures of scale parameter

Usage

\[
\text{Weibullmix}(x, v, \alpha, \lambda, \text{weight} = \text{rep}(1, \text{length}(x)), m = 300, \\
\text{eps} = 1e^{-06}, \text{hist} = \text{FALSE}, \text{rtol} = 1e^{-06}, \text{verb} = 0, \text{control} = \text{NULL})
\]

Arguments

- \(x\): Survival times
- \(v\): Grid values for mixing distribution
- \(\alpha\): Shape parameter for Weibull distribution
- \(\lambda\): Scale parameter for Weibull Distribution
- \(m\): Number of \(v\) grid points
- \(\text{weight}\): Frequency (count) for survival times
- \(\text{eps}\): Tolerance parameter
- \(\text{hist}\): If TRUE aggregate to histogram counts
- \(\text{rtol}\): Convergence tolerance for optimization
- \(\text{verb}\): Verboseness of optimization
- \(\text{control}\): Mosek control list see KWDual documentation

Details

Kiefer Wolfowitz NPMLE density estimation for Weibull scale mixtures. The histogram option is intended for relatively large problems, say \(n > 1000\), where reducing the sample size dimension is desirable. By default the grid for the binning is equally spaced on the support of the data. The optimization is carried out by calls to the function mosek in the required package Rmosek.

Value

An object of class density with components

- \(x\): points of evaluation on the domain of the density
- \(y\): estimated function values at the points \(x\), the mixing density
- \(\log\text{Lik}\): Log likelihood value at the proposed solution
- \(\text{flag}\): exit code from the optimizer
Author(s)

Roger Koenker and Jiaying Gu

References


See Also

Weibullmix

Description

A Kiefer-Wolfowitz procedure for ML estimation of a Gaussian model with independent mean and variance components with weighted longitudinal data. This version assumes a general bivariate distribution for the mixing distribution.

Usage

```r
WGLVmix(y, id, w, u, v, pu = 30, pv = 30, eps = 1e-06, rtol = 1.0e-6, verb = 0, control = NULL)
```

Arguments

- `y`: A vector of observations
- `id`: A strata indicator vector of the same length
- `w`: A vector of weights
- `u`: A vector of bin boundaries for the mean effects
- `v`: A vector of bin boundaries for the variance effects
- `pu`: The number of mean effect bins, if `u` is missing
- `pv`: The number of variance effect bins, if `u` is missing
- `eps`: A tolerance for determining the support of the bins
- `rtol`: A tolerance for determining duality gap convergence tolerance in Mosek
- `verb`: A flag indicating how verbose the Mosek output should be
- `control`: Mosek control list see KWDual documentation
Details

The vector v can be specified as a scalar; in this case no mixture distribution for variances is estimated, instead the variance distribution is set to be point mass one at the value specified by the scalar. This is (potentially) useful for inference about the need for a variance mixture. See Gu and Koenker (2013)

Value

A list consisting of the following components:

- u: the mean bin boundaries
- v: the variance bin boundaries
- fuv: the function values of the mixing density for the variances.
- logLik: log likelihood value for mean problem
- status: Mosek convergence status

Author(s)

R. Koenker and J. Gu

References


Description

A Kiefer-Wolfowitz procedure for ML estimation of a Gaussian model with independent variance components with weighted longitudinal data.

Usage

\[
\text{WGVmix}(y, \text{id}, w, v, pv = 300, \text{eps} = 1e^{-06}, \text{rtol} = 1.0e{-6}, \text{verb} = 0, \text{control} = \text{NULL})
\]

Arguments

- y: A vector of observations
- id: A strata indicator vector of the same length
- w: A vector of weights
- v: A vector of bin boundaries for the variance effects
- pv: The number of variance effect bins, if u is missing
- eps: A tolerance for determining the support of the bins
WTLVmix

rtol A tolerance for determining duality gap convergence tolerance in Mosek
verb A flag indicating how verbose the Mosek output should be
control Mosek control list see KWDual documentation

Details
See Gu and Koenker (2012?)

Value
An object of class density consisting of the following components:
x the variance bin boundaries
y the function values of the mixing density for the variances.
logLik the value of the log likelihood at the solution
status the mosek convergence status.

Author(s)
R. Koenker

References

WTLVmix WTLVmix: Weighted Maximum Likelihood for Empirical Bayes Estimation of Longitudinal Gaussian Means and Variances Model

Description
A Kiefer-Wolfowitz procedure for ML estimation of a Gaussian model with independent mean and variance components with weighted longitudinal data. This version employs a Student t version of the likelihood.

Usage
WTLVmix(y, id, w, u, v, pu = 300, pv = 300, eps = 1e-06, rtol = 1.0e-6, verb = 0, control = NULL)
Arguments

- **y**: A vector of observations
- **id**: A strata indicator vector of the same length
- **w**: A vector of weights
- **u**: A vector of bin boundaries for the mean effects
- **v**: A vector of bin boundaries for the variance effects
- **pu**: The number of mean effect bins, if `u` is missing
- **pv**: The number of variance effect bins, if `u` is missing
- **eps**: A tolerance for determining the support of the bins
- **rtol**: A tolerance for determining duality gap convergence tolerance in Mosek
- **verb**: A flag indicating how verbose the Mosek output should be
- **control**: Mosek control list see KWDual documentation

Details

The vector `v` can be specified as a scalar; in this case no mixture distribution for variances is estimated, instead the variance distribution is set to be point mass one at the value specified by the scalar. This is (potentially) useful for inference about the need for a variance mixture. See Gu and Koenker (2013)

Value

A list consisting of the following components:

- **u**: the mean bin boundaries
- **fu**: the function values of the mixing density for the means
- **v**: the variance bin boundaries
- **fv**: the function values of the mixing density for the variances.
- **logLik**: log likelihood value for mean problem
- **status**: Mosek convergence status

Author(s)

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