Package ‘INLABMA’

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bmarho

Description
This function performs a weighted average of the component fitted.values from a list of INLA objects.

Usage
bmarho(models, rho, logrhoprior = rep(1, length(rho)))

Arguments
- models: List of INLA models fitted for different values of rho
- rho: Vector of values of rho used to compute the list in models.
- logrhoprior: Log-prior density for each value of rho.

Details
The different fitted.values are weighted using the values of the marginal likelihood of the fitted models and the prior of parameter rho. rho is a parameter that is fixed when computing models and that have a log-prior density defined in pogrhoprior.

Value
Vector of averaged fitted values.

Author(s)
Virgilio Gómez-Rubio <virgilio.gomez@uclm.es>

References

See Also
INLABMA
**fitmarg**

*Fit posterior marginal distributions to points*

---

**Description**

Compute (and re-scale, if necessary) the marginal from a set of points `x` and values of log-likelihood `logy` and log-prior density `logp`.

**Usage**

```r
fitmarg(x, logy, logp = 0, usenormal = FALSE)
```

**Arguments**

- `x`: Values of the random variable.
- `logy`: Log-likelihood.
- `logp`: Log-prior density.
- `usenormal`: Whether use a Normal distribution for the fitted marginal.

**Details**

Fits a marginal at a set of points `x` from their log-likelihood and log-prior. The fitted marginal is re-scaled to integrate one if necessary. If `usenormal`=TRUE then the fitted marginal is supposed to be Normal, which is computed using the posterior mean and standard deviation of `x`.

**Value**

A function with the fitted marginal is returned.

**Author(s)**

Virgilio Gómez-Rubio <virgilio.gomez@uclm.es>

**See Also**

`fitmargBMA`, `fitmargBMA2`, `mysplinefun`
fitmargBMA Compute marginals using Bayesian Model Averaging

Description

fitmargBMA takes a list of marginal distributions and weights (presumably, based on some marginal likelihoods) and computes a final distribution by weighting.

fitmargBMA2 takes a list of INLA models and computes Bayesian Model Averaging on some of their components.

fitmatrixBMA performs averaging on a list of matrices.

fitlistBMA performs averaging of elements in lists.

Usage

fitmargBMA(margs, ws, len = 100)
fitmargBMA2(models, ws, item)
fitmatrixBMA(models, ws, item)
fitlistBMA(models, ws, item)

Arguments

margs List of 2-column matrices with the values of the (marginal) distributions.
models List of INLA models to be averaged.
ws Vector of weights. They do not need to sum up to one.
len Length of the x-vector to compute the weighted distribution.
item Name of the elements of an INLA object to be used in the Model Averaging.

Details

For fitmargBMA, distributions provided are averaging according to the weights provided. A new probability distribution is obtained.

fitmargBMA2 uses a list of INLA models to compute Model Averaging on some of their components (for example, the fitted values).

fitmatrixBMA performs averaging on a list of matrices.

fitlistBMA performs averaging of a list of a list of matrices.

Value

fitmargBMA returns a 2-column matrix with the weighted marginal distribution.
fitmargBMA2 returns a list of weighted components.
fitmatrixBMA returns a matrix.
fitlistBMA returns a list.
INLABMA

Perform complete Bayesian Model Averaging on some Spatial Econometrics models

Description

This function performs Bayesian Model Averaging on a list of different Spatial Econometrics models. These models have been computed under different values of the spatial autocorrelation parameter \( \rho \).

Usage

```r
INLABMA(models, rho, logrhoprior = rep(1, length(rho)), impacts = FALSE, usenormal = FALSE)
```

Arguments

- **models**: List of INLA models, computed for different values of \( \rho \).
- **rho**: A vector with the values of \( \rho \) used to compute models.
- **logrhoprior**: Vector with the values of the log-prior density of \( \rho \).
- **impacts**: Logical. Whether impacts should be computed.
- **usenormal**: Logical. Whether the posterior marginal of \( \rho \) is assumed to be Gaussian.

Details

This functions performs BMA on most of the components of an INLA model using the marginal likelihoods of the models and the provided log-prior density of \( \rho \).

Value

A list with the averaged components. Another component called \( \rho \) is added, with its posterior marginal and some other summary information.

Author(s)

Virgilio Gómez-Rubio <virgilio.gomez@uclm.es>

References


INLAMH

\textit{Perform INLA with MCMC.}

\textbf{Description}

This function implements the Metropolis-Hastings algorithm using repeated calls to R-INLA to fit conditional model on the current state of the MCMC simulations.

\textbf{Usage}

\texttt{INLAMH(d, fit.inla, b.init, rq, dq, prior, n.sim = 200, n.burnin = 100, n.thin = 1, n.errors = 20, verbose = FALSE)}

\textbf{Arguments}

\begin{itemize}
  \item \texttt{d} \hspace{1cm} Data.frame with the data used to fit the model with R-INLA.
  \item \texttt{fit.inla} \hspace{1cm} A function used to fit the model with R-INLA. It should take at least two arguments: a data.frame (first) and an object with the actual value of the sampled parameters. This function must return a vector of two components: model.sim (an 'inla' object with the fitted model) and 'mlik' (the marginal likelihood as returned by INLA in model.sim$mlik).
  \item \texttt{b.init} \hspace{1cm} Initial values of the model parameters for the Metropolis-Hastings algorithm.
  \item \texttt{rq} \hspace{1cm} Sampling from the proposal distribution. It must take one argument: the current state of the Markov chain.
  \item \texttt{dq} \hspace{1cm} Density of the proposal distribution. It takes two arguments: current state and proposed new state.
  \item \texttt{prior} \hspace{1cm} Prior distribution of the model parameters.
  \item \texttt{n.sim} \hspace{1cm} Total of simulations to be done.
  \item \texttt{n.burnin} \hspace{1cm} Number of burn-in simulation (thinning is ignored here).
  \item \texttt{n.thin} \hspace{1cm} Thinning to be applied to the simulations after burn-in.
  \item \texttt{n.errors} \hspace{1cm} This is the number of errors allowed when calling inla().
  \item \texttt{verbose} \hspace{1cm} Whether to show some running information or not (default to FALSE).
\end{itemize}

\textbf{Details}

This function implements the Metropolis-Hastings algorithm using INLA (i.e., INLA within MCMC) at every step. In practice, only a few of the model parameters are sampled in the MCMC steps and the posterior marginal of the remainder of parameters is obtained by Bayesian model averaging of the conditional marginals returned by R-INLA at each step of the Metropolis-Hastings algorithm.

\textbf{See Also}

\texttt{sem.inla, slm.inla, sdm.inla}
**leroux.inla**

**Value**

A list with three components:

- `acc.sim` A vector of logical values (of length `n.sim`) showing whether a given proposal has been accepted or not. This is useful to compute the acceptance rate.
- `model.sim` A list with the models fitted, as returned by `fit.inla()`.
- `b.sim` List of all sampled values of the models parameters. It is a list because the sampled values can be vectors.

**Author(s)**

Virgilio Gómez-Rubio.

**References**


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**leroux.inla**  
*Fit Leroux et al’s spatial model.*

**Description**

This function fits the model by Leroux et al. for a given value of the parameter `lambda`, i.e., the mixture parameter that appears in the variance.

**Usage**

`leroux.inla(formula, d, W, lambda, improve = TRUE, fhyper = NULL, ...)`

**Arguments**

- `formula` Formula of the fixed effects.
- `d` A data.frame with the data to be used.
- `W` Adjacency matrix.
- `lambda` Parameter used in the mixture of the two precission matrices.
- `improve` Logical. Whether to improve the fitted models to obtain better estimates of the marginal likelihoods.
- `fhyper` Extra arguments passed to the definition of the hyperparameters.
- `...` Extra arguments passed to function `inla`.

**Details**

This function fits the model proposed by Leroux et al. (1999) for a given value of parameter `lambda`. This parameter controls the mixture between a diagonal precission (`lambda=1`) and an intrinsic CAR precission (`lambda=0`). The marginal log-likelihood is corrected to add half the log-determinant of the precission matrix.
**logprrho**

**Value**
An INLA object.

**Author(s)**
Virgilio Gómez-Rubio <virgilio.gomez@uclm.es>

**References**

**See Also**
[sem.inla](#), [slm.inla](#), [sdm.inla](#)

---

**logprrho**

*Log-prior density for the spatial autocorrelation parameter rho*

**Description**
Compute log-prior density for rho

**Usage**

```r
logprrho(rho)
```

**Arguments**

- `rho` The value to compute the log-density.

**Details**
This function computes the log-density of the prior for rho according to logit(rho) ~ N(0, prec=.1). This is one of the default priors in **R-INLA** for spatial autocorrelation parameters.

**Value**
Numerical.

**Author(s)**
Virgilio Gómez-Rubio <virgilio.gomez@uclm.es>
mysplinefun

Examples

```r
rrho<-seq(.01, .99, length.out=100)
plot(rrho, exp(logprrho(rrho)))
```

 mysplinefun  Compute spline function

Description

This function is similar to splinefun but it returns 0 outside the range of x.

Usage

```r
mysplinefun(x, y = NULL, method = c("fmm", "periodic", "natural", "monoH.FC")[1],
ties = mean)
```

Arguments

- **x**: x-values to use in the interpolation.
- **y**: y-values to use in the interpolation (optional).
- **method**: Method used to compute the spline. See splinefun for details.
- **ties**: Handling of tied 'x' values. See splinefun for details.

Details

This function calls splinefun and returns a function with the fitted spline. The main difference is that this new function returns 0 outside the range of 0.

Value

Returns a function with x and deriv arguments. See splinefun for details.

Author(s)

Virgilio Gómez-Rubio <virgilio.gomez@uclm.es>

See Also

- splinefun
recompute.impacts

Recompute the impact summaries from the marginals

Description

This function recomputes the impacts summaries using the (approximated) marginals rather than by weighting on the different summaries.

Usage

recompute.impacts(obj, impacts = c("total", "direct", "indirect"))

Arguments

obj Object with a resulting model obtained by Bayesian Model Averaging with INLABMA.
impacts Types of impacts to recompute.

Details

This function uses the impacts marginals to compute some summary statistics. By default, the summary of the impacts is obtained by weighting the different summaries used in Bayesian Model Averaging with function INLABMA.

Value

Original object with the updated summary statistics of the impacts.

Author(s)

Virgilio Gómez-Rubio <virgilio.gomez@uclm.es>

References

Bivand et al. (2013)

See Also

INLABMA
**rescalemarg**

Re-scale marginal distribution to compute the distribution of \( w \times x \)

**Description**

This function takes a marginal distribution (represented by a 2-column matrix) and computes the marginal distribution of \( w \times x \).

**Usage**

```r
rescalemarg(xx, w)
```

**Arguments**

- **xx**: 2-column matrix with x and y-values.
- **w**: Weight to re-scale the y-values.

**Details**

This function simply re-scales

**Value**

A 2-column matrix with the new values of \( w \times x \) and their associated probability densities. This is also an object of classes `inla.marginal`.

**Author(s)**

Virgilio Gómez-Rubio &lt;virgilio.gomez@uclm.es&gt;

**References**

INLA

**See Also**

`inla.tmarginal`

**Examples**

```r
if(requireNamespace("INLA", quietly = TRUE)) {
  require(INLA)
  x<-seq(-3,3, by=.01)
  xx<-cbind(x, dnorm(x))
  xx2<-rescalemarg(xx, 3)
  plot(xx, type="l", xlim=c(-9,9))
}
sem.inla

Fit spatial econometrics models with INLA

Description

These functions fit some spatial econometrics models for a given value of \( \rho \) (the spatial autocorrelation parameter). `sem.inla` fits a spatial error model, `slm` fits a spatial lag model and `sdm.inla` fits a spatial Durbin model.

Usage

```r
sem.inla(formula, d, W, rho, improve = TRUE, impacts = FALSE, fhyper = NULL, probit = FALSE, ...)
slm.inla(formula, d, W, rho, mmatrix = NULL, improve = TRUE, impacts = FALSE, fhyper = NULL, probit = FALSE, ...)
sdm.inla(formula, d, W, rho, mmatrix = NULL, intercept = TRUE, impacts = FALSE, improve = TRUE, fhyper = NULL, probit = FALSE, ...)
sac.inla(formula, d, W, rho, W.lambda, rho, lambda, mmatrix = NULL, improve = TRUE, impacts = FALSE, fhyper = NULL, probit = FALSE, ...)
```

Arguments

- `formula` Formula with the response variable, the fixed effects and, possibly, other non-linear effects.
- `d` Data.frame with the data.
- `W` Adjacency matrix.
- `rho` Value of the spatial autocorrelation parameter. For the SAC model, spatial autocorrelation term on the response.
- `W.rho` For the SAC model, adjacency matrix associated to the autocorrelation on the response.
- `W.lambda` For the SAC model, adjacency matrix associated to the autocorrelation on the error term.
- `lambda` For the SAC model, spatial autocorrelation of the error term.
- `mmatrix` Design matrix of fixed effects.
- `intercept` Logical. Whether an intercept has been included in the model.
- `improve` Logical. Whether improve model fitting (this may require more computing time).
- `impacts` Logical. Whether impacts are computed.
fhyper

Options to be passed to the definition of the hyper-parameters in the spatial effects.

probit

Logical. Whether a probit model is used. Note this is only used when computing the impacts and that argument family must be set accordingly.

... Other arguments passed to function inla.

Details

These functions fit a spatial econometrics model with a fixed value of the spatial autocorrelation parameter rho.

In addition, the marginal -log-likelihood is corrected to account for the variance-covariance matrix of the error term or random effects.

Value

An inla object.

Author(s)

Virgilio Gómez-Rubio <virgilio.gomez@uclm.es>

References


See Also

leroux.inla

Examples

## Not run:

if(requireNamespace("INLA", quietly = TRUE)) {
  require(INLA)
  require(spdep)

  data(columbus)

  lw <- nb2listw(col.gal.nb, style="W")

  #Maximum Likelihood (ML) estimation
colsemml <- errorsarlm(CRIME ~ INC + HOVAL, data=columbus, lw, method="eigen",}
quiet=FALSE)
cols1ml <- lagsarl(CRIME ~ INC + HOVAL, data=columbus, lw, method="eigen", type="lag", quiet=FALSE)
colsdml <- lagsarl(CRIME ~ INC + HOVAL, data=columbus, lw, method="eigen", type="mixed", quiet=FALSE)

#Define grid on rho
rrho<-seq(-1, .95, length.out=40)

#Adjacency matrix
W <- as(as_dgRMatrix_listw(nb2listw(col.gal.nb)), "CsparseMatrix")
#Index for spatial random effects
columbus$idx<-1:nrow(columbus)

#Formula
form<- CRIME ~ INC + HOVAL
zero.variance = list(prec=list(initial = 25, fixed=TRUE))

seminla<-mclapply(rrho, function(rho){
    sem.inla(form, d=columbus, W=W, rho=rho,
             family = "gaussian", impacts=FALSE,
             control.family = list(hyper = zero.variance),
             control.predictor=list(compute=TRUE),
             control.compute=list(dic=TRUE, cpo=TRUE),
             control.inla=list(print.joint.hyper=TRUE),
             #tolerance=1e-20, h=1e-6),
             verbose=FALSE
        )
})

slminla<-mclapply(rrho, function(rho){
    slm.inla(form, d=columbus, W=W, rho=rho,
             family = "gaussian", impacts=FALSE,
             control.family = list(hyper = zero.variance),
             control.predictor=list(compute=TRUE),
             control.compute=list(dic=TRUE, cpo=TRUE),
             control.inla=list(print.joint.hyper=TRUE),
             #tolerance=1e-20, h=1e-6),
             verbose=FALSE
        )
})

sdminla<-mclapply(rrho, function(rho){

trIrhoWinv

Compute trace of $(I-rho*W)^{-1}$ matrix

Description

This function computes (or estimates) the trace of matrix $(I-rho*W)^{-1}$, which is often needed when computing impacts in some spatial econometrics models.

Usage

trIrhoWinv(W, rho, offset = 0, order = 20, direct = TRUE, Df = Matrix::Diagonal(nrow(W)))

Arguments

- **W**: Adjacency matrix. Usually, it is row-standardised.
- **rho**: Value of spatial autocorrelation parameter rho.
offset  
Number of times \((I-\rho W)^{-1}\) is multiplied by \(W\) (for sdm model).

order  
Order of Taylor expansion used in the approximation of the trace.

direct  
Use direct method, i.e., matrix multiplication, etc.

df  
Diagonal matrix used to compute the impacts in the Probit model only used if \texttt{direct=TRUE}.

Details
This function computes the trace of \((I-\rho W)^{-1}\), which is later used to computed the impacts. This is an internal function.

Value
Numerica value.

Author(s)
Virgilio Gómez-Rubio <virgilio.gomez@uclm.es>

References

See Also
\texttt{sem.inla, slm.inla, sdm.inla}
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