bayesQR is an MCMC sampler to fit a Bayesian quantile regression model. This does not assume a factor structure.

**Arguments**

- **formula**: A formula of the form `formula = Y ~ X1 + X2`, where `Y` is the response and variables on the right-hand side are covariates.
- **dataSet**: An optional data frame, list, or environment containing the variables in the model.
- **pQuant**: Response quantile to model. Defaults to `pQuant=PNU`.
- **nSamp**: Number of MCMC iterations, with a default of 5000.
- **burn**: Iterations of burn-in, with a default of 0.
- **thin**: Number of iterations to skip between stored values, with a default of 0.
- **β0**: Prior shape for `τ`, which is the inverse scale of the response. Defaults to 1.
- **D0**: Prior scale for `τ`.
- **B0**: Prior precision (i.e., inverse variance) for β regression parameters. Default is a diagonal matrix with non-zero values of 0.01. May be left at NULL, or changed to a non-negative scalar, a vector with length equal to the number of covariates, or a symmetric, positive semi-definite matrix with dimension equal to the number of covariates.
- **betaZero**: Starting value for β.
- **verbose**: If TRUE, prints progress updates in Gibbs sampler.

**Value**

Returns an item of the class bayesQR composed of the following components:

- **param**: Matrix of sampled parameter values.
- **call**: The matched call.
- **betLen**: The number of β components.
- **nObs**: The number of observations.
- **burn**: The number of Gibbs iterations before samples were stored.
- **thin**: The number of Gibbs iterations between stored values.
- **nSamp**: The total number of Gibbs iterations.

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checkFcn

Check function

Description
checkFcn is the check function, or tilted absolute value function.

Arguments
- **x**: A vector of points at which we evaluate the function.
- **p**: The quantile of interest.

Value
Returns a vector with the same length as x. The check loss is defined to be -1*(x < 0)*x*(1-p) + (x>0)*p*x.

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factorQR

A Bayesian factor model for quantile regression

Description
factorQR is an MCMC sampler to fit a Bayesian factor model for quantile regression.

Arguments
- **factorForm**: A formula of the form factorForm = Y ~ X1 + X2, where Y is the response and variables on the right-hand side are manifest variables related to the latent factors on which we are regressing Y. The right-hand side variables will be centered automatically, though they are not scaled.
- **nonFactorForm**: An optional formula of the form nonFactorForm = ~ X3 + X4. These covariates are used to model Y, but they do not relate to any of the latent factors.
- **dataset**: An optional data frame, list, or environment containing the variables in the model.
- **pQuant**: Response quantile to model. Defaults to pQuant=0.5.
- **whichFactor**: Vector of indicators to show factor grouping. E.g., if whichFactor=c(1,1,1,2,2,2), it would mean the first three variables in the right-hand side of factorForm group and the last three group together in two factors. If whichFactor = NULL, a single latent factor will be assumed.
- **nSamp**: Number of MCMC iterations, with a default of 5000.
burn

Iterations of burn-in, with a default of 0.

thin

Number of iterations to skip between stored values in the chain, with a default of 0.

cTau0

Prior shape for $\tau$, which is the inverse scale of the response. Defaults to 1.

dTau0

Prior scale for $\tau$.

cPsi0

Prior shape for $\Psi$, the inverse scale of the manifest variables related to the factors. Defaults to 1.

dPsi0

Prior rate for $\Psi$. Defaults to 1.

sig0

Hyperparameter for scale of free $\Lambda_{-s}$ variables, which is rows of the factor loading matrix that do not correspond to the response. Defaults to 1.

mu0

Prior mean for $\Lambda_{-s}$ components. Defaults to 1.

R0

Prior scale of $\Phi^{-1}$. If not specified, defaults to the identity matrix.

nu0

Prior degrees of freedom for inverse Wishart associated with $\Phi$. Must be an integer greater than or equal to the dimension of $\Phi$, but defaults to one greater than that dimension.

B0s

Prior precision (i.e., inverse variance) for $\Lambda_s$. Default is a diagonal matrix with non-zero values of 0.01. May be left at NULL, or changed to a non-negative scalar, a vector with length equal to the number of latent factors, or a symmetric, positive definite matrix with dimension equal to the number of latent factors.

B0Beta

Prior precision for regression coefficients related to nonFactorForm. Default is a diagonal matrix with non-zero values of 0.01. May be left at NULL, or changed to a non-negative scalar, a vector with length equal to the number of covariates not related to the latent factors, or a symmetric, positive definite matrix with that dimension.

betaZero

Starting value for $\beta$.

PhiZero

Initial value of $\Phi$.

invPsiZero

Initial value of $\Psi^{-1}$.

LambdaZero

Initial value of $\Lambda_{-s}$. Must be a scalar or vector with length equal to the number of manifest variables in the right-hand side of factorForm. Will be expanded to its matrix form internally, and elements that should be fixed at 1 will be adjusted if necessary, with warning.

LambdaSZero

Initial value of last row of $\Lambda$, i.e. the part that models the left-hand side of factorForm. If specified, must either be a scalar or vector with length equal to the number of latent factors being modeled. Defaults to 0.1

OmegaZero

Initial value for latent $\Omega$.

verbose

If TRUE, prints progress updates in Gibbs sampler.

storeOmega

If TRUE, stores the sampled $\Omega$ values.

latentInteract

If TRUE, interacts the first two latent factors. More latent/latent interactions are not currently supported.

interactX

If supplied, a matrix of variables with which to interact the latent factors. Repeated columns are allowed.

whichFactorInteract

A vector that indicates which factors to interact with the columns of interactX. For example, whichFactorInteract = c(1,1) would indicate that the two columns of interactX are to be interacted with the first latent factor.
**Value**

Returns an item of the class factorQR composed of the following components:

- **param**
  Matrix of sampled parameter values.
- **call**
  The matched call.
- **nReg**
  The number of regression parameters.
- **betLen**
  The number of $\beta$ components.
- **nObs**
  The number of observations.
- **burn**
  The number of Gibbs iterations before samples were stored.
- **thin**
  The number of Gibbs iterations between stored values.
- **nSamp**
  The total number of Gibbs iterations.
- **nFact**
  The number of modeled latent factors.
- **nFactorX**
  The number of manifest variables related to the factors.
- **omega**
  Sampled $\Omega$ values, if storeOmega is TRUE.
- **nFactInt**
  Number of factor/manifest variable interactions.

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**makeData**

*Function to make synthetic data for the factorQR function*

**Description**

makeData simulates data from a factor quantile regression model.

**Arguments**

- **N**
  The sample size.
- **whichFactor**
  A vector that indicates which factor each manifest variable relates to. E.g.,
  **whichFactor** = c(1,1,1,2,2) would indicate a two-factor model, with the
  first three manifest variables relating to the first factor and the second two to
  the second factor.
- **pQuant**
  The quantile of interest. Defaults to 0.5.
- **lambda**
  The vector of the non-zero elements of the factor loading matrix, with length
  equal to that of **whichFactor**. Do not include the factor loadings related to the
  response variable. Defaults to 1.
- **LambdaS**
  The vector of factor loadings related to the response. Must have length equal to
  the number of distinct values in **whichFactor**. Defaults to 0.
- **Phi**
  Matrix of latent factor covariances. Must be symmetric and positive-definite and
  have dimension equal to the number of latent factors. Defaults to the identity
  matrix.
- **lapScale**
  Scale of the asymmetric Laplace error distribution. Defaults to 1.
- **Psi**
  Vector of error variances for the manifest explanatory variables.
Value

Returns a matrix whose first column is the response \( Y \) and whose remaining columns are the explanatory manifest variables with the underlying factor grouping implied by \texttt{whichFactor}.

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