Package ‘zic’

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Title Bayesian Inference for Zero-Inflated Count Models

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Description Provides MCMC algorithms for the analysis of zero-inflated count models. The case of stochastic search variable selection (SVS) is also considered. All MCMC samplers are coded in C++ for improved efficiency. A data set considering the demand for health care is provided.

License GPL (>= 2)

Depends R (>= 3.0.2)

Imports Rcpp (>= 0.11.0), coda (>= 0.14-2)

LinkingTo Rcpp, RcppArmadillo

NeedsCompilation yes

Repository CRAN

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R topics documented:

`docvisits` *Demand for Health Care Data*

Description

This data set gives the number of doctor visits in the last three months for a sample of German male individuals in 1994. The data set is taken from Riphahn et al. (2003) and is a subsample of the German Socioeconomic Panel (SOEP). In contrast to Riphahn et al. (2003) only male individuals from the last wave are considered. See Jochmann (2013) for further details.

Usage

```
data(docvisits)
```

Format

This data frame contains 1812 observations on the following 22 variables:

docvisits number of doctor visits in last 3 months

age age

agesq age squared / 1000

age30 1 if age >= 30

age35 1 if age >= 35

age40 1 if age >= 40

age45 1 if age >= 45

age50 1 if age >= 50

age55 1 if age >= 55

age60 1 if age >= 60

health health satisfaction, 0 (low) - 10 (high)

handicap 1 if handicapped, 0 otherwise

hdegree degree of handicap in percentage points

married 1 if married, 0 otherwise

schooling years of schooling

hhincome household monthly net income, in German marks / 1000

children 1 if children under 16 in the household, 0 otherwise

self 1 if self employed, 0 otherwise

civil 1 if civil servant, 0 otherwise

bluec 1 if blue collar employee, 0 otherwise

employed 1 if employed, 0 otherwise

public 1 if public health insurance, 0 otherwise

addon 1 if add-on insurance, 0 otherwise

References

Jochmann, M. (2013). "What Belongs Where? Variable Selection for Zero-Inflated Count Models with an Application to the Demand for Health Care", *Computational Statistics*, 28, 1947–1964.

Riphahn, R. T., Wambach, A., Million, A. (2003). "Incentive Effects in the Demand for Health Care: A Bivariate Panel Count Data Estimation", *Journal of Applied Econometrics*, 18, 387–405.

Wagner, G. G., Frick, J. R., Schupp, J. (2007). "The German Socio-Economic Panel Study (SOEP) – Scope, Evolution and Enhancements", *Schmollers Jahrbuch*, 127, 139–169.

`zic` *Bayesian Inference for Zero-Inflated Count Models*

Description

`zic` fits zero-inflated count models via Markov chain Monte Carlo methods.

Usage

```
zic(formula, data, a0, b0, c0, d0, e0, f0,
    n.burnin, n.mcmc, n.thin, tune = 1.0, scale = TRUE)
```

Arguments

`formula`	A symbolic description of the model to be fit specifying the response variable and covariates.
`data`	A data frame in which to interpret the variables in `formula`.
`a0`	The prior variance of α.
`b0`	The prior variance of β_j.
`c0`	The prior variance of γ.
`d0`	The prior variance of δ_j.
`e0`	The shape parameter for the inverse gamma prior on σ^2.
`f0`	The inverse scale parameter the inverse gamma prior on σ^2.
`n.burnin`	Number of burn-in iterations of the sampler.
`n.mcmc`	Number of iterations of the sampler.
`n.thin`	Thinning interval.
`tune`	Tuning parameter of Metropolis-Hastings step.
`scale`	If true, all covariates (except binary variables) are rescaled by dividing by their respective standard errors.

Details

The considered zero-inflated count model is given by

$$y_i^* \sim \text{Poisson}[\exp(\eta_i^*)],$$

$$\eta_i^* = \alpha + x_i'\beta + \varepsilon_i,\ \varepsilon_i \sim \text{N}(0, \sigma^2),$$

$$d_i^* = \gamma + x_i'\delta + \nu_i,\ \nu_i \sim \text{N}(0, 1),$$

$$y_i = 1(d_i^* > 0)y_i^*,$$

where y_i and x_i are observed. The assumed prior distributions are

$$\alpha \sim \text{N}(0, a_0),$$

$$\beta_k \sim \text{N}(0, b_0), \quad k = 1, \ldots, K,$$

$$\gamma \sim \text{N}(0, c_0),$$

$$\delta_k \sim \text{N}(0, d_0), \quad k = 1, \ldots, K,$$

$$\sigma^2 \sim \text{Inv-Gamma}\left(e_0, f_0\right).$$

The sampling algorithm described in Jochmann (2013) is used.

Value

A list containing the following elements:

`alpha`	Posterior draws of α (coda mcmc object).
`beta`	Posterior draws of β (coda mcmc object) .
`gamma`	Posterior draws of γ (coda mcmc object).
`delta`	Posterior draws of δ (coda mcmc object).
`sigma2`	Posterior draws of σ^2 (coda mcmc object).
`acc`	Acceptance rate of the Metropolis-Hastings step.

References

Jochmann, M. (2013). “What Belongs Where? Variable Selection for Zero-Inflated Count Models with an Application to the Demand for Health Care”, *Computational Statistics*, 28, 1947–1964.

Examples

```
## Not run:
data( docvisits )
mdl <- docvisits ~ age + agesq + health + handicap + hdegree + married + schooling +
                   hhincome + children + self + civil + bluec + employed + public + addon
post <- zic( f, docvisits, 10.0, 10.0, 10.0, 10.0, 1.0, 1.0, 1000, 10000, 10, 1.0, TRUE )
## End(Not run)
```

`zic.svs` *SVS for Zero-Inflated Count Models*

Description

`zic.svs` applies SVS to zero-inflated count models

Usage

```
zic.svs(formula, data,
        a0, g0.beta, h0.beta, nu0.beta, r0.beta, s0.beta, e0, f0,
        c0, g0.delta, h0.delta, nu0.delta, r0.delta, s0.delta,
        n.burnin, n.mcmc, n.thin, tune = 1.0, scale = TRUE)
```

Arguments

`formula`	A symbolic description of the model to be fit specifying the response variable and covariates.
`data`	A data frame in which to interpret the variables in `formula`.
`a0`	The prior variance of α.
`g0.beta`	The shape parameter for the inverse gamma prior on κ_k^β.
`h0.beta`	The inverse scale parameter for the inverse gamma prior on κ_k^β.
`nu0.beta`	Prior parameter for the spike of the hypervariances for the β_k.
`r0.beta`	Prior parameter of ω^β.
`s0.beta`	Prior parameter of ω^β.
`e0`	The shape parameter for the inverse gamma prior on σ^2.
`f0`	The inverse scale parameter the inverse gamma prior on σ^2.
`c0`	The prior variance of γ.
`g0.delta`	The shape parameter for the inverse gamma prior on κ_k^δ.
`h0.delta`	The inverse scale parameter for the inverse gamma prior on κ_k^δ.
`nu0.delta`	Prior parameter for the spike of the hypervariances for the δ_k.
`r0.delta`	Prior parameter of ω^δ.
`s0.delta`	Prior parameter of ω^δ.
`n.burnin`	Number of burn-in iterations of the sampler.
`n.mcmc`	Number of iterations of the sampler.
`n.thin`	Thinning interval.
`tune`	Tuning parameter of Metropolis-Hastings step.
`scale`	If true, all covariates (except binary variables) are rescaled by dividing by their respective standard errors.

Details

The considered zero-inflated count model is given by

$$y_i^* \sim \mathrm{Poisson}[\exp(\eta_i^*)],$$

$$\eta_i^* = \alpha + x_i'\beta + \varepsilon_i,\ \varepsilon_i \sim \mathrm{N}(0, \sigma^2),$$
$$d_i^* = \gamma + x_i'\delta + \nu_i,\ \nu_i \sim \mathrm{N}(0, 1),$$
$$y_i = 1(d_i^* > 0)y_i^*,$$

where y_i and x_i are observed. The assumed prior distributions are

$$\alpha \sim \mathrm{N}(0, a_0),$$

$$\beta_k \sim \mathrm{N}(0, \tau_k^\beta \kappa_k^\beta),, \quad k = 1, \ldots, K,$$
$$\kappa_j^\beta \sim \text{Inv-Gamma}(g_0^\beta, h_0^\beta),$$
$$\tau_k^\beta \sim (1 - \omega^\beta)\delta_{\nu_0^\beta} + \omega^\beta \delta_1,$$
$$\omega^\beta \sim \mathrm{Beta}(r_0^\beta, s_0^\beta),$$
$$\gamma \sim \mathrm{N}(0, c_0),$$
$$\delta_k \sim \mathrm{N}(0, \tau_k^\delta \kappa_k^\delta), \quad k = 1, \ldots, K,$$
$$\kappa_k^\delta \sim \text{Inv-Gamma}(g_0^\delta, h_0^\delta),$$
$$\tau_k^\delta \sim (1 - \omega^\delta)\delta_{\nu_0^\delta} + \omega^\delta \delta_1,$$
$$\omega^\delta \sim \mathrm{Beta}(r_0^\delta, s_0^\delta),$$
$$\sigma^2 \sim \text{Inv-Gamma}\left(e_0, f_0\right).$$

The sampling algorithm described in Jochmann (2013) is used.

Value

A list containing the following elements:

`alpha`	Posterior draws of α (coda mcmc object).
`beta`	Posterior draws of β (coda mcmc object).
`gamma`	Posterior draws of γ (coda mcmc object).
`delta`	Posterior draws of δ (coda mcmc object).
`sigma2`	Posterior draws of σ^2 (coda mcmc object).
`I.beta`	Posterior draws of indicator whether τ_j^β is one (coda mcmc object).
`I.delta`	Posterior draws of indicator whether τ_j^δ is one (coda mcmc object).
`omega.beta`	Posterior draws of ω^β (coda mcmc object).
`omega.delta`	Posterior draws of ω^δ (coda mcmc object).
`acc`	Acceptance rate of the Metropolis-Hastings step.

References

Jochmann, M. (2013). “What Belongs Where? Variable Selection for Zero-Inflated Count Models with an Application to the Demand for Health Care”, *Computational Statistics*, 28, 1947–1964.

Examples

```
## Not run:
data( docvisits )
mdl <- docvisits ~ age + agesq + health + handicap + hdegree + married + schooling +
                   hhincome + children + self + civil + bluec + employed + public + addon
post <- zic.ssvs( mdl, docvisits,
                  10.0, 5.0, 5.0, 1.0e-04, 2.0, 2.0, 1.0, 1.0,
                  10.0, 5.0, 5.0, 1.0e-04, 2.0, 2.0,
                  1000, 10000, 10, 1.0, TRUE )
## End(Not run)
```

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