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

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**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**
```r
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


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**Description**

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

**Usage**

```r
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 $\alpha$.
- `b0`: The prior variance of $\beta_j$.
- `c0`: The prior variance of $\gamma$.
- `d0`: The prior variance of $\delta_j$.
- `e0`: The shape parameter for the inverse gamma prior on $\sigma^2$.
- `f0`: The inverse scale parameter the inverse gamma prior on $\sigma^2$.
- `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.
The considered zero-inflated count model is given by
\[
y^*_i \sim \text{Poisson}\{\exp(\eta^*_i)\},
\eta^*_i = \alpha + x'_i \beta + \varepsilon_i, \quad \varepsilon_i \sim \text{N}(0, \sigma^2),
d^*_i = \gamma + x'_i \delta + \nu_i, \quad \nu_i \sim \text{N}(0, 1),
y_i = 1(d^*_i > 0)y^*_i,
\]
where \(y_i\) and \(x_i\) are observed. The assumed prior distributions are
\[
\alpha \sim \text{N}(0, a_0),
\beta_k \sim \text{N}(0, b_0), \quad k = 1, \ldots, K,
\gamma \sim \text{N}(0, c_0),
\delta_k \sim \text{N}(0, d_0), \quad k = 1, \ldots, K,
\sigma^2 \sim \text{Inv-Gamma}(e_0, f_0).
\]
The sampling algorithm described in Jochmann (2013) is used.

A list containing the following elements:
- alpha: Posterior draws of \(\alpha\) (coda mcmc object).
- beta: Posterior draws of \(\beta\) (coda mcmc object).
- gamma: Posterior draws of \(\gamma\) (coda mcmc object).
- delta: Posterior draws of \(\delta\) (coda mcmc object).
- sigma2: Posterior draws of \(\sigma^2\) (coda mcmc object).
- acc: Acceptance rate of the Metropolis-Hastings step.

References


Examples

```r
## 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)
```
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 $\alpha$.
- **g0.beta**: The shape parameter for the inverse gamma prior on $\kappa_\beta^k$.
- **h0.beta**: The inverse scale parameter for the inverse gamma prior on $\kappa_\beta^k$.
- **nu0.beta**: Prior parameter for the spike of the hypervariances for the $\beta_k$.
- **r0.beta**: Prior parameter of $\omega_\beta$.
- **s0.beta**: Prior parameter of $\omega_\beta$.
- **e0**: The shape parameter for the inverse gamma prior on $\sigma^2$.
- **f0**: The inverse scale parameter the inverse gamma prior on $\sigma^2$.
- **c0**: The prior variance of $\gamma$.
- **g0.delta**: The shape parameter for the inverse gamma prior on $\kappa_\delta^k$.
- **h0.delta**: The inverse scale parameter for the inverse gamma prior on $\kappa_\delta^k$.
- **nu0.delta**: Prior parameter for the spike of the hypervariances for the $\delta_k$.
- **r0.delta**: Prior parameter of $\omega_\delta$.
- **s0.delta**: Prior parameter of $\omega_\delta$.
- **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

\[ y^*_i \sim \text{Poisson}[\exp(\eta^*_i)], \]
\[ \eta^*_i = \alpha + x_i' \beta + \varepsilon_i, \varepsilon_i \sim \mathcal{N}(0, \sigma^2), \]
\[ d^*_i = \gamma + x_i' \delta + \nu_i, \nu_i \sim \mathcal{N}(0, 1), \]
\[ y_i = 1(d^*_i > 0)y^*_i, \]

where \( y_i \) and \( x_i \) are observed. The assumed prior distributions are

\[ \alpha \sim \mathcal{N}(0, a_0), \]
\[ \beta_k \sim \mathcal{N}(0, \tau_{\beta_k} \kappa_{\beta_k}), \quad k = 1, \ldots, K, \]
\[ \kappa_{\beta} \sim \text{Inv-Gamma}(g_{\beta_0}, h_{\beta_0}), \]
\[ \tau_{\beta_k} \sim (1 - \omega_{\beta}) \delta_{\nu_{\beta}} + \omega_{\beta} \delta_1, \]
\[ \omega_{\beta} \sim \text{Beta}(r_{\beta_0}, s_{\beta_0}), \]
\[ \gamma \sim \mathcal{N}(0, c_0), \]
\[ \delta_k \sim \mathcal{N}(0, \tau_{\delta_k} \kappa_{\delta_k}), \quad k = 1, \ldots, K, \]
\[ \kappa_{\delta} \sim \text{Inv-Gamma}(g_{\delta_0}, h_{\delta_0}), \]
\[ \tau_{\delta_k} \sim (1 - \omega_{\delta}) \delta_{\nu_{\delta}} + \omega_{\delta} \delta_1, \]
\[ \omega_{\delta} \sim \text{Beta}(r_{\delta_0}, s_{\delta_0}), \]
\[ \sigma^2 \sim \text{Inv-Gamma}(e_0, f_0). \]

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

Value

A list containing the following elements:

- `alpha`: Posterior draws of \( \alpha \) (coda mcmc object).
- `beta`: Posterior draws of \( \beta \) (coda mcmc object).
- `gamma`: Posterior draws of \( \gamma \) (coda mcmc object).
- `delta`: Posterior draws of \( \delta \) (coda mcmc object).
- `sigma2`: Posterior draws of \( \sigma^2 \) (coda mcmc object).
- `I.beta`: Posterior draws of indicator whether \( \tau_{j}^\beta \) is one (coda mcmc object).
- `I.delta`: Posterior draws of indicator whether \( \tau_{j}^{\delta} \) is one (coda mcmc object).
- `omega.beta`: Posterior draws of \( \omega^\beta \) (coda mcmc object).
- `omega.delta`: Posterior draws of \( \omega^{\delta} \) (coda mcmc object).
- `acc`: Acceptance rate of the Metropolis-Hastings step.
References


Examples

```r
## 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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