Package ‘ZIM’

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Description

Fits observation-driven and parameter-driven models for count time series with excess zeros.

Details

The package ZIM contains functions to fit statistical models for count time series with excess zeros (Yang et al., 2013, 2014+). The main function for fitting observation-driven models is `zim`, and the main function for fitting parameter-driven models is `dzim`.

Note

The observation-driven models for zero-inflated count time series can also be fit using the function `zeroinfl` from the `pscl` package (Zeileis et al., 2008). Fitting parameter-driven models is based on sequential Monte Carlo (SMC) methods, which are computer intensive and could take several hours to estimate the model parameters.

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References


bshift

**Backshift Operator**

**Description**
Apply the backshift operator or lag operator to a time series objective.

**Usage**
```
bshift(x, k = 1)
```

**Arguments**
- `x`: univariate or multivariate time series.
- `k`: number of lags.

**Examples**
```
x <- arima.sim(model = list(ar = 0.8, sd = 0.5), n = 120)
bshift(x, k = 12)
```

dzim

**Fitting Dynamic Zero-Inflated Models**

**Description**
dzim is used to fit dynamic zero-inflated models.

**Usage**
```
dzim(formula, data, subset, na.action, weights = 1, offset = 0,
      control = dzim.control(...), ...)
```

**Arguments**
- `formula`: an objective of class "formula".
- `data`: an optional dataframe, list or environment containing the variables in the model.
- `subset`: an optional vector specifying a subset of observations to be used in the fitting process.
- `na.action`: a function which indicates what should happen when the data contain NAs.
- `weights`: an optional vector of 'prior weights' to be used in the fitting process.
- `offset`: this can be used to specify a priori known component to be included in the linear predictor during fitting.
- `control`: control arguments from dzim.control
- `...`: additional arguments
dzim.control

Auxiliary for Controlling DZIM Fitting

Description

Auxiliary function for dzim fitting. Typically only used internally by dzim.fit, but may be used to construct a control argument for either function.

Usage

dzim.control(dist = c("poisson", "nb", "zip", "zinb"), trace = FALSE, 
start = NULL, order = 1, mu0 = rep(0, order), Sigma0 = diag(1, order), 
N = 1000, R = 1000, niter = 500)

Arguments

dist  count model family
trace  logical; if TRUE, display iteration history.
start  initial parameter values.
order  autoregressive order.
mu0   mean vector for initial state.
Sigma0 covariance matrix for initial state.
N     number of particles in particle filtering.
R     number of replications in particle smoothing.
niter number of iterations.

Note

The default values of N, R, and niter are chosen based on our experience. In some cases, N = 500, R = 500, and niter = 200 might be sufficient. The dzim.plot function should always be used for convergence diagnostics.

See Also

dzim, dzim.fit, dzim.filter, dzim.smooth, dzim.sim, dzim.plot
**dzim.filter**

*Particle Filtering for DZIM*

**Description**

Function to implement the particle filtering method proposed by Gordsill et al. (1993).

**Usage**

```r
dzim.filter(y, X, w, para, control)
```

**Arguments**

- `y`: response variable.
- `X`: design matrix.
- `w`: log(w) is used as an offset variable in the linear predictor.
- `para`: model parameters.
- `control`: control arguments.

**References**


**See Also**

`dzim, dzim.fit, dzim.smooth, dzim.control, dzim.sim, dzim.plot`

---

**dzim.fit**

*Fitter Function for Dynamic Zero-Inflated Models*

**Description**

`dzim.fit` is the basic computing engine called by `dzim` used to fit dynamic zero-inflated models. This should usually not be used directly unless by experienced users.

**Usage**

```r
dzim.fit(y, X, offset = rep(0, n), control = dzim.control(...), ...)
```
Arguments

- \( y \) response variable.
- \( X \) design matrix.
- offset offset variable.
- control control arguments.
- ... additional arguments.

See Also
dzim, dzim.control, dzim.filter, dzim.smooth, dzim.sim, dzim.plot

dzim.plot

Trace Plots from DZIM

Description

Function to display trace plots from a dynamic zero-inflated model.

Usage

dzim.plot(object, k.inv = FALSE, sigma.sq = FALSE, ...)

Arguments

- object objective from dzim or dzim.fit.
- k.inv logical; indicating whether an inverse transformation is needed for the dispersion parameter.
- sigma.sq logical; indicating whether a square transformation is needed for the standard deviation parameter.
- ... additional arguments.

dzim.sim

Simulate Data from DZIM

Description

Simulate data from a dynamic zero-inflated model.

Usage

dzim.sim(X, w, omega, k, beta, phi, sigma, mu0, Sigma0)
dzim.smooth

Arguments

- **X** design matrix.
- **w** \( \log(w) \) is used as an offset variable in the linear predictor.
- **omega** zero-inflation parameter.
- **k** dispersion parameter.
- **beta** regression coefficients.
- **phi** autoregressive coefficients.
- **sigma** standard deviation.
- **mu0** mean vector of initial state.
- **Sigma0** covariance matrix of initial state.

See Also

dzim, dzimNfit, dzimNfilter, dzim.smooth, dzim.control, dzim.plot

dzimNsmooth

Particle Smoothing for DZIM

Description

Function to implement the particle smoothing method proposed by Gordsill et al. (2004).

Usage

dzimNsmooth(y, X, w, para, control)

Arguments

- **y** response variable.
- **X** design matrix.
- **w** \( \log(w) \) is used as an offset variable in the linear predictor.
- **para** model parameters.
- **control** control arguments.

References


See Also

dzim, dzim.fit, dzim.filter, dzim.control, dzim.sm, dzim.plot
**injury**  
*Example: Injury Series from Occupational Health*

**Description**
Monthly number of injuries in hospitals from July 1988 to October 1995.

**Source**
Numbers from Figure 1 of Yau et al. (2004).

**References**

**Examples**
data(injury)  
plot(injury, type = "o", pch = 20, xaxt = "n", yaxt = "n", ylab = "Injury Count")  
axis(side = 1, at = seq(1, 96, 8))  
axis(side = 2, at = 0:9)  
abline(v = 57, lty = 2)  
mtext("Pre-intervention", line = 1, at = 25, cex = 1.5)  
mtext("Post-intervention", line = 1, at = 80, cex = 1.5)

---

**pvalue**  
*Function to Compute P-value.*

**Description**
Function to compute p-value based on a t-statistic.

**Usage**
pvalue(t, df = Inf, alternative = c("two.sided", "less", "greater"))

**Arguments**
- **t**: t-statistic.
- **df**: degree of freedoms.
- **alternative**: type of alternatives.

**Examples**
pvalue(1.96, alternative = "greater")
**Example: Syphilis Series**

**Description**
Weekly number of syphilis cases in the United States from 2007 to 2010.

**Format**
A data frame with 209 observations on the following 69 variables.

<table>
<thead>
<tr>
<th>year</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>week</td>
<td>Week</td>
</tr>
<tr>
<td>a1</td>
<td><strong>United States</strong></td>
</tr>
<tr>
<td>a2</td>
<td><strong>New England</strong></td>
</tr>
<tr>
<td>a3</td>
<td>Connecticut</td>
</tr>
<tr>
<td>a4</td>
<td>Maine</td>
</tr>
<tr>
<td>a5</td>
<td>Massachusetts</td>
</tr>
<tr>
<td>a6</td>
<td>New Hampshire</td>
</tr>
<tr>
<td>a7</td>
<td>Rhode Island</td>
</tr>
<tr>
<td>a8</td>
<td>Vermont</td>
</tr>
<tr>
<td>a9</td>
<td><strong>Mid. Atlantic</strong></td>
</tr>
<tr>
<td>a10</td>
<td>New Jersey</td>
</tr>
<tr>
<td>a11</td>
<td>New York (Upstate)</td>
</tr>
<tr>
<td>a12</td>
<td>New York City</td>
</tr>
<tr>
<td>a13</td>
<td>Pennsylvania</td>
</tr>
<tr>
<td>a14</td>
<td><strong>E.N. Central</strong></td>
</tr>
<tr>
<td>a15</td>
<td>Illinois</td>
</tr>
<tr>
<td>a16</td>
<td>Indiana</td>
</tr>
<tr>
<td>a17</td>
<td>Michigan</td>
</tr>
<tr>
<td>a18</td>
<td>Ohio</td>
</tr>
<tr>
<td>a19</td>
<td>Wisconsin</td>
</tr>
<tr>
<td>a20</td>
<td><strong>W.N. Central</strong></td>
</tr>
<tr>
<td>a21</td>
<td>Iowa</td>
</tr>
<tr>
<td>a22</td>
<td>Kansas</td>
</tr>
<tr>
<td>a23</td>
<td>Minnesota</td>
</tr>
<tr>
<td>a24</td>
<td>Missouri</td>
</tr>
<tr>
<td>a25</td>
<td>Nebraska</td>
</tr>
<tr>
<td>a26</td>
<td>North Dakota</td>
</tr>
<tr>
<td>a27</td>
<td>South Dakota</td>
</tr>
<tr>
<td>a28</td>
<td><strong>S. Atlantic</strong></td>
</tr>
<tr>
<td>a29</td>
<td>Delaware</td>
</tr>
<tr>
<td>a30</td>
<td>District of Columbia</td>
</tr>
<tr>
<td>a31</td>
<td>Florida</td>
</tr>
<tr>
<td>a32</td>
<td>Georgia</td>
</tr>
<tr>
<td>a33</td>
<td>Maryland</td>
</tr>
<tr>
<td>a34</td>
<td>North Carolina</td>
</tr>
</tbody>
</table>
a35  South Carolina
a36  Virginia
a37  West Virginia
a38  E.S. Central
a39  Alabama
a40  Kentucky
a41  Mississippi
a42  Tennessee
a43  W.S. Central
a44  Arkansas
a45  Louisiana
a46  Oklahoma
a47  Texas
a48  Moutain
a49  Arizona
a50  Colorado
a51  Idaho
a52  Montana
a53  Nevada
a54  New Mexico
a55  Utah
a56  Wyoming
a57  Pacific
a58  Alaska
a59  California
a60  Hawaii
a61  Oregon
a62  Washington
a63  American Samoa
a64  C.N.M.I.
a65  Guam
a66  Peurto Rico
a67  U.S. Virgin Islands

Note

C.N.M.I.: Commonwealth of Northern Mariana Islands.

Source

CDC Morbidity and Mortality Weekly Report (http://www.cdc.gov/MMWR/).

Examples

data(syph)
plot(ts(syph$a33), main = "Maryland")
Fitting Zero-Inflated Models

Description

zim is used to fit zero-inflated models.

Usage

zim(formula, data, subset, na.action, weights = 1, offset = 0, control = zim.control(...), ...)

Arguments

formula  an objective of class "formula".
data  an optional dataframe, list or environment containing the variables in the model.
subset  an optional vector specifying a subset of observations to be used in the fitting process.
na.action  a function which indicates what should happen when the data contain NAs.
weights  an optional vector of 'prior weights' to be used in the fitting process.
offset  this can be used to specify a priori known component to be included in the linear predictor during fitting.
control  control arguments.
...  additional arguments.

Note

zim is very similar to zeroinfl from the pscl package. Both functions can be used to fit observation-driven models for zero-inflated time series.

See Also

zim.fit, zim.control
zim.control  Auxiliary for Controlling ZIM Fitting

Description

Auxiliary function for zim fitting. Typically only used internally by zim.fit, but may be used to construct a control argument for either function.

Usage

zim.control(dist = c("zip", "znb"), method = c("EM-NR", "EM-FS"),
    type = c("solve", "ginv"), robust = FALSE, trace = FALSE,
    start = NULL, minit = 10, maxit = 10000, epsilon = 1e-08)

Arguments

- dist: count model family.
- type: type of matrix inverse.
- robust: logical; if TRUE, robust standard errors will be calculated.
- trace: logical; if TRUE, display iteration history.
- start: initial parameter values.
- minit: minimum number of iterations.
- maxit: maximum number of iterations.
- epsilon: positive convergence tolerance.

See Also

zim, zim.fit

zim.fit  Fitter Function for Zero-Inflated Models

Description

zim.fit is the basic computing engine called by zim used to fit zero-inflated models. This should usually not be used directly unless by experienced users.

Usage

zim.fit(y, X, Z, weights = rep(1, nobs), offset = rep(0, nobs),
    control = zim.control(...), ...)


Arguments

- **y**: response variable.
- **X**: design matrix for log-linear part.
- **Z**: design matrix for logistic part.
- **weights**: an optional vector of 'prior weights' to be used in the fitting process.
- **offset**: offset variable
- **control**: control arguments from `zim.control`.
- **...**: additional arguments.

See Also

`zim, zim.control`

---

**ZINB**

*The Zero-Inflated Negative Binomial Distribution*

---

**Description**

Density, distribution function, quantile function and random generation for the zero-inflated negative binomial (ZINB) distribution with parameters k, lambda, and omega.

**Usage**

```r
dzinb(x, k, lambda, omega, log = FALSE)
pzinb(q, k, lambda, omega, lower.tail = TRUE, log.p = FALSE)
qzinb(p, k, lambda, omega, lower.tail = TRUE, log.p = FALSE)
rzinb(n, k, lambda, omega)
```

**Arguments**

- **x, q**: vector of quantiles.
- **p**: vector of probabilities.
- **n**: number of random values to return.
- **k**: dispersion parameter.
- **lambda**: vector of (non-negative) means.
- **omega**: zero-inflation parameter.
- **log, log.p**: logical; if TRUE, probabilities p are given as log(p).
- **lower.tail**: logical; if TRUE (default), probabilities are P[X <= x], otherwise, P[X > x].

**Value**

dzinb gives the density, pzinb gives the distribution function, qzinb gives the quantile function, and rzinb generates random deviates.
The Zero-Inflated Poisson Distribution

### Description
Density, distribution function, quantile function and random generation for the zero-inflated Poisson (ZIP) distribution with parameters \( \lambda \) and \( \omega \).

### Usage
- `dzip(x, lambda, omega, log = FALSE)`
- `pzip(q, lambda, omega, lower.tail = TRUE, log.p = FALSE)`
- `qzip(p, lambda, omega, lower.tail = TRUE, log.p = FALSE)`
- `rzinb(n, lambda, omega)`

### Arguments
- `x, q` vector of quantiles.
- `p` vector of probabilities.
- `n` number of random values to return.
- `lambda` vector of (non-negative) means.
- `omega` zero-inflation parameter.
- `log, log.p` logical; if TRUE, probabilities \( p \) are given as \( \log(p) \).
- `lower.tail` logical; if TRUE (default), probabilities are \( P[X \leq x] \), otherwise, \( P[X > x] \).

### Value
- `dzip` gives the density, `pzip` gives the distribution function, `qzip` gives the quantile function, and `rzinb` generates random deviates.

### See Also
- `dzinb`, `pzinb`, `qzinb`, and `rzinb` for the zero-inflated negative binomial (ZINB) distribution.
Examples

dzip(x = 0:10, lambda = 1, omega = 0.5)
pzip(q = c(1, 5, 9), lambda = 1, omega = 0.5)
qzip(p = c(0.25, 0.50, 0.75), lambda = 1, omega = 0.5)
rzip(n = 100, lambda = 1, omega = 0.5)
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