# Package ‘Countr’

January 14, 2024

**Type**  Package  
**Title**  Flexible Univariate Count Models Based on Renewal Processes  
**Version**  3.5.8  
**Description**  Flexible univariate count models based on renewal processes. The models may include covariates and can be specified with familiar formula syntax as in `glm()` and package 'flexsurv'. The methodology is described by Kharrat et all (2019) <doi:10.18637/jss.v090.i13> (included as vignette 'Countr_guide' in the package). If the suggested package 'pscl' is not available from CRAN, it can be installed with 'remotes::install_github("cran/pscl")'. It is no longer used by the functions in this package but is needed for some of the extended examples.  
**License**  GPL (>= 2)  
**URL**  [https://geobosh.github.io/Countr/](https://geobosh.github.io/Countr/) (doc), [https://github.com/GeoBosh/Countr](https://github.com/GeoBosh/Countr) (devel)  
**BugReports**  [https://github.com/GeoBosh/Countr/issues](https://github.com/GeoBosh/Countr/issues)  
**Depends**  R (>= 3.3.0)  
**Imports**  Matrix, Rcpp (>= 0.11.3), flexsurv, Formula, VGAM, optimx, numDeriv, boot, MASS, car, utils, Rdpack (>= 0.7-0), lattice, RColorBrewer, dplyr, standardize, lmtest, xtable  
**LinkingTo**  Rcpp, RcppArmadillo  
**Suggests**  testthat, knitr, pscl  
**RdMacros**  Rdpack  
**VignetteBuilder**  knitr  
**LazyData**  true  
**RoxygenNote**  7.2.3  
**NeedsCompilation**  yes  
R topics documented:

'renewal_IV.R' 'renewal_tools.R' 'renewal_cstr.R' 'tools.R'
'renewal_methods.R'

Config/build/clean-inst-doc FALSE

Author  Tarak Kharrat [aut],
        Georgi N. Boshnakov [aut, cre]

Maintainer  Georgi N. Boshnakov <georgi.boshnakov@manchester.ac.uk>

Repository  CRAN

Date/Publication  2024-01-14 15:50:05 UTC

R topics documented:

Countr-package .................................................. 3
addBootSampleObject ............................................ 3
chiSq_gof ......................................................... 4
chiSq_pearson .................................................... 5
compareToGLM ..................................................... 6
CountrFormula .................................................... 7
count_table ...................................................... 7
dCount_conv_bi .................................................. 8
dCount_conv_loglik_bi .......................................... 10
dmodifiedCount_bi .............................................. 12
dWeibullCount .................................................... 14
dWeibullgammaCount_mat_Covariates .......................... 16
evCount_conv_bi .................................................. 16
fertility .......................................................... 18
football .......................................................... 19
frequency_plot .................................................... 20
getParNames ....................................................... 20
predict.renewal ................................................... 21
renewalCoef ....................................................... 22
renewalCoefList .................................................. 23
renewalCount ...................................................... 24
renewalNames ..................................................... 28
renewal_methods .................................................. 28
residuals_plot .................................................... 31
se.coef .......................................................... 31
surv .............................................................. 32

Index  34
Flexible univariate count models based on renewal processes. The models may include covariates and can be specified with familiar formula syntax as in glm() and `flexsurv`.

Details

The methodology is described by Kharrat et al. (2019). The paper is included in the package as vignette vignette('Countr_guide_paper', package = 'Countr')).

The main function is `renewalCount`, see its documentation for examples.

Goodness of fit chi-square (likelihood ratio and Pearson) tests for glm and count renewal models are implemented in `chiSq_gof` and `chiSq_pearson`.

References


---

**addBootSampleObject** Create a bootstrap sample for coefficient estimates

Description

Create a bootstrap sample from coefficient estimates.

Usage

`addBootSampleObject(object, ...)`
Arguments

object  
an object to add boot object to.

...  
extra parameters to be passed to the boot::boot() function other than data and statistic.

Details

The information in object is used to prepare the arguments and then boot is called to generate the bootstrap sample. The bootstrap sample is stored in object as component "boot". Arguments in "..." can be used customise the boot() call.

Value

object with additional component "boot"

See Also

renewal_methods

Examples

## see renewal_methods

---

chiSq_gof  
Formal Chi-square goodness-of-fit test

Description

Carry out the formal chi-square goodness-of-fit test described by Cameron (2013).

Usage

chiSq_gof(object, breaks, ...)

## S3 method for class 'renewal'
chiSq_gof(object, breaks, ...)

## S3 method for class 'negbin'
chiSq_gof(object, breaks, ...)

## S3 method for class 'glm'
chiSq_gof(object, breaks, ...)
chiSq_pearson

Arguments

object an object from class renewal.
breaks integer values at which the breaks should happen. The function will compute the observed frequencies in the intervals [breaks[i], breaks[i + 1]).
... currently not used.

Details

The test is a conditional moment test described in details in Cameron (2013, Section 5.3.4). We compute the asymptotically equivalent outer product of the gradient version which is justified for renewal models (fully parametric + parameters based on MLE).

Value
data.frame

References


See Also

chiSq_pearson

---

**chiSq_pearson**  
Pearson Chi-Square test

Description

Carry out Pearson Chi-Square test and compute the Pearson statistic.

Usage

chiSq_pearson(object, ...)

## S3 method for class 'renewal'
chiSq_pearson(object, ...)

## S3 method for class 'glm'
chiSq_pearson(object, ...)

Arguments

object an object from class renewal.
... currently not used.
compareToGLM

Details
The computation is inspired from Cameron(2013) Chapter 5.3.4. Observed and fitted frequencies are computed and the contribution of every observed cell to the Pearson’s chi-square test statistic is reported. The idea is to check if the fitted model has a tendency to over or under predict some ranges of data.

Value
data.frame with 5 columns given the count values (Counts), observed frequencies (Actual), model’s prediction (Predicted), the difference (Diff) and the contribution to the Pearson’s statistic (Pearson).

References

See Also
chiSq_gof

compareToGLM(poisson_model, breaks, nbinom_model, ...)

Arguments
poisson_model fitted Poisson glm model
breaks integer values at which the breaks should happen. The function will compute the observed frequencies in the intervals [breaks[i],breaks[i + 1]).
nbinom_model fitted negative binomial (fitted using MASS::glm.nb()). This argument is optional.
... renewal models to be considered.

Details
This function computes a data.frame similar to Table 5.6 in Cameron(2013), using the observed frequencies and predictions from different models. Supported models accepted are Poisson and negative binomial (fitted using MASS::glm.nb()) from the glm family and any model from the renewal family (passed in ...).
Value

data.frame with columns Counts, Actual (observed probability) and then 2 columns per model passed (predicted probability and pearson statistic) for the associated count value.

References


---

**CountrFormula**

Create a formula for renewalCount

**Description**

Create a formula for renewalCount

**Usage**

CountrFormula(response, ...)

**Arguments**

- **response**: the formula for the "main" parameter. It also specifies the response variable.
- **...**: additional arguments for the ancilliary parameters.

**Value**

a Formula object suitable for argument formula of renewalCount().

---

**count_table**

Summary of a count variable

**Description**

Summary of a count variable.

**Usage**

count_table(count, breaks, formatChar = FALSE)

**Arguments**

- **count**: integer, observed count value for every individual in the sample.
- **breaks**: integer, values at which the breaks should happen. The function will compute the observed frequency in [breaks[i], breaks[i + 1]].
- **formatChar**: logical, should the values be converted to character and formatted?
Details

The function does a similar job to `table()` with more flexibility introduced by the argument `breaks`. The user can decide how to break the count values and decide to merge some cells if needed.

Value

`matrix` with 2 rows and `length(breaks)` columns. The column names are the cells names. The rows are the observed frequencies and relative frequencies (probabilities).

---

### dCount_conv_bi

*Compute count probabilities using convolution*

Description

Compute count probabilities using one of several convolution methods. `dCount_conv_bi` does the computations for the distributions with built-in support in this package.

`dCount_conv_user` does the same using a user-defined survival function.

Usage

```r
# Compute count probabilities using convolution

dCount_conv_bi(
  x,  
distPars,  
dist = c("weibull", "gamma", "gengamma", "burr"),  
method = c("dePril", "direct", "naive"),  
nsteps = 100,  
time = 1,  
extrap = TRUE,  
log = FALSE  
)

dCount_conv_user(
  x,  
distPars,  
extrapolPars,  
survR,  
method = c("dePril", "direct", "naive"),  
nsteps = 100,  
time = 1,  
extrap = TRUE,  
log = FALSE  
)
```
**Arguments**

- **x**: integer (vector), the desired count values.
- **distPars**: Rcpp::List with distribution specific slots, see details.
- **dist**: character name of the built-in distribution, see details.
- **method**: character string, the method to use, see Details.
- **nsteps**: unsigned integer, number of steps used to compute the integral.
- **time**: double, time at which to compute the probabilities. Set to 1 by default.
- **extrap**: logical, if TRUE, Richardson extrapolation will be applied to improve accuracy.
- **log**: logical, if TRUE the log-probability will be returned.
- **extrapolPars**: vector of length 2, the extrapolation values.
- **survR**: function, user supplied survival function; should have signature `function(t, distPars)` where `t` is a positive real number (the time where the survival function is evaluated) and `distPars` is a list of distribution parameters. It should return a double value.

**Details**

dCount_conv_bi computes count probabilities using one of several convolution methods for the distributions with built-in support in this package.

The following convolution methods are implemented: "dePril", "direct", and "naive".

The built-in distributions currently are Weibull, gamma, generalized gamma and Burr.

**Value**

vector of probabilities $P(x(i), i = 1, ..., n)$ where $n$ is the length of $x$.

**Examples**

```r
x <- 0:10
lambda <- 2.56
p0 <- dpois(x, lambda)
ll <- sum(dpois(x, lambda, TRUE))
err <- 1e-6

## all-probs convolution approach
distPars <- list(scale = lambda, shape = 1)
pmat_bi <- dCount_conv_bi(x, distPars, "weibull", "direct",
nsteps = 200)

## user pwei
pwei_user <- function(tt, distP) {
  alpha <- exp(-log(distP["scale"])) / distP["shape"]
  pweibull(q = tt, scale = alpha, shape = distP["shape"],
           lower.tail = FALSE)
}

pmat_user <- dCount_conv_user(x, distPars, c(1, 2), pwei_user, "direct",
```

---

**dCount_conv_bi**

9
## naive convolution approach

```r
pmat_bi <- dCount_conv_bi(x, distPars, "weibull", "naive",
                           nsteps = 200)
pmat_user <- dCount_conv_user(x, distPars, c(1, 2), pwei_user, "naive",
                              nsteps = 200)
max((pmat_bi - p0)^2 / p0)
max((pmat_user - p0)^2 / p0)
```

## dePril conv approach

```r
pmat_bi <- dCount_conv_bi(x, distPars, "weibull", "dePril",
                           nsteps = 200)
pmat_user <- dCount_conv_user(x, distPars, c(1, 2), pwei_user, "dePril",
                              nsteps = 200)
max((pmat_bi - p0)^2 / p0)
max((pmat_user - p0)^2 / p0)
```

---

dCount_conv_loglik_bi  
*Log-likelihood of a count probability computed by convolution (bi)*

### Description

Compute the log-likelihood of a count model using convolution methods to compute the probabilities. dCount_conv_loglik_bi is for the builtin distributions. dCount_conv_loglik_user is for user defined survival functions.

### Usage

```r
dCount_conv_loglik_bi(  
  x,  
  distPars,  
  dist = c("weibull", "gamma", "gengamma", "burr"),  
  method = c("dePril", "direct", "naive"),  
  nsteps = 100,  
  time = 1,  
  extrapol = TRUE,  
  na.rm = TRUE,  
  weights = NULL  
)
```

```r
dCount_conv_loglik_user(  
  x,  
  distPars,  
  extrapolPars,  
  survR,  
  survUser,  
  extrapolUser,  
)
```

method = c("dePril", "direct", "naive"),
nsteps = 100,
time = 1,
extrap = TRUE,
na.rm = TRUE,
weights = NULL)
}

**Arguments**

- **x**: integer (vector), the desired count values.
- **distPars**: list of the same length as x with each slot being itself a named list containing the distribution parameters corresponding to x[i].
- **dist**: character name of the built-in distribution, see details.
- **method**: character, convolution method to be used; choices are "dePril" (section 3.2), "direct" (section 2) or "naive" (section 3.1).
- **nsteps**: unsigned integer number of steps used to compute the integral.
- **time**: double time at which to compute the probabilities. Set to 1 by default.
- **extrap**: logical, if TRUE, Richardson extrapolation will be applied to improve accuracy.
- **na.rm**: logical, if TRUE, NAs (produced by taking the log of very small probabilities) will be replaced by the smallest allowed probability; default is TRUE.
- **weights**: numeric, vector of weights to apply. If NULL, a vector of ones.
- **extrapolPars**: list of same length as x where each slot is a vector of length 2 (the extrapolation values to be used) corresponding to x[i].
- **survR**: a user defined survival function; should have the signature function(t, distPars) where t is a real number (>0) where the survival function is evaluated and distPars is a list of distribution parameters. It should return a double value.

**Value**

numeric, the log-likelihood of the count process

**Examples**

x <- 0:10
lambda <- 2.56
distPars <- list(scale = lambda, shape = 1)
distParsList <- lapply(seq_along = x), function(ind) distPars)
extrapolParsList <- lapply(seq_along = x), function(ind) c(2, 1))
## user pwei
pwei_user <- function(tt, distP) {
  alpha <- exp(-log(distP[["scale"]]) / distP[["shape"]])
pweibull(q = tt, scale = alpha, shape = distP[["shape"]],
  lower.tail = FALSE)
}

## log-likelihood allProbs Poisson
Compute count probabilities based on modified renewal process (bi)

Description
Compute count probabilities based on modified renewal process using dePril algorithm. dmodifiedCount_bi does it for the builtin distributions.
dmodifiedCount_user does the same for a user specified distribution.

Usage

```r

dmodifiedCount_bi(
  x,
  distPars,
  dist,
  distPars0,
  dist0,
  nsteps = 100L,
  time = 1,
  extrapol = TRUE,
  cdfout = FALSE,
  logFlag = FALSE
)

dmodifiedCount_user(
  x,
  distPars,
```
Arguments

- **x**: integer (vector), the desired count values.
- **distPars0, distPars**: Rcpp::List with distribution specific slots for the first arrival and the rest of the process respectively.
- **dist0, dist**: character, name of the first and following survival distributions.
- **nsteps**: unsigned integer number of steps used to compute the integral.
- **time**: double time at which to compute the probabilities. Set to 1 by default.
- **extrap**: logical if TRUE, Richardson extrapolation will be applied to improve accuracy.
- **cdfout**: TODO
- **logFlag**: logical if TRUE the log-probability will be returned.
- **survR0, survR**: user supplied survival function; should have signature function(t, distPars). where t is a positive real number (the time at which the survival function is evaluated) and distPars is a list of distribution parameters. It should return a double value (first arrival and following arrivals respectively).
- **extrapolPars**: list of same length as x, where each slot is a vector of length 2 (the extrapolation values to be used) corresponding to x[i].

Details

For the modified renewal process the first arrival is allowed to have a different distribution from the time between subsequent arrivals. The renewal assumption is kept.

Value

vector of probabilities $P(x(i))$ for $i = 1, ..., n$ where $n$ is the length of x.
**Description**

Probability computations for the univariate Weibull count process. Several methods are provided. `dWeibullCount` computes probabilities.

`dWeibullCount_loglik` computes the log-likelihood.

`evWeibullCount` computes the expected value and variance.

**Usage**

```r
dWeibullCount(
  x,
  shape,
  scale,
  method = c("series_acc", "series_mat", "conv_direct", "conv_naive", "conv_dePril"),
  time = 1,
  log = FALSE,
  conv_steps = 100,
  conv_extrap = TRUE,
  series_terms = 50,
  series_acc_niter = 300,
  series_acc_eps = 1e-10
)
```

```r
dWeibullCount_loglik(
  x,
  shape,
  scale,
  method = c("series_acc", "series_mat", "conv_direct", "conv_naive", "conv_dePril"),
  time = 1,
  na.rm = TRUE,
  conv_steps = 100,
  conv_extrap = TRUE,
  series_terms = 50,
  series_acc_niter = 300,
  series_acc_eps = 1e-10,
  weights = NULL
)
```

```r
evWeibullCount(
  xmax,
  shape,
  scale,
  method = c("series_acc", "series_mat", "conv_direct", "conv_naive", "conv_dePril"),
)```
Arguments

- **x** integer (vector), the desired count values.
- **shape** numeric (length 1), shape parameter of the Weibull count.
- **scale** numeric (length 1), scale parameter of the Weibull count.
- **method** character, one of the available methods, see details.
- **time** double, length of the observation window (defaults to 1).
- **log** logical, if TRUE, the log of the probability will be returned.
- **conv_steps** numeric, number of steps used for the extrapolation.
- **conv_extrap** logical, should Richardson extrapolation be applied ?
- **series_terms** numeric, number of terms in the series expansion.
- **series_acc_niter** numeric, number of iterations in the Euler-van Wijngaarden algorithm.
- **series_acc_eps** numeric, tolerance of convergence in the Euler-van Wijngaarden algorithm.
- **na.rm** logical, if TRUE NA's (produced by taking the log of very small probabilities) will be replaced by the smallest allowed probability; default is TRUE.
- **weights** numeric, vector of weights to apply. If NULL, a vector of one's will be applied.
- **xmax** unsigned integer, maximum count to be used.

Details

Argument method can be used to specify the desired method, as follows:

- "series_mat" - series expansion using matrix techniques,
- "series_acc" - Euler-van Wijngaarden accelerated series expansion (default),
- "conv_direc" - direct convolution method of section 2,
- "conv_naive" - naive convolution described in section 3.1,
- "conv_dePril" - dePril convolution described in section 3.2.

The arguments have sensible default values.

Value

for dWeibullCount, a vector of probabilities \( P(x(i)), i = 1, \ldots , n \), where \( n = \text{length}(x) \).
for dWeibullCount_loglik, a double, the log-likelihood of the count process.
for evWeibullCount, a list with components:

- **ExpectedValue** expected value,
- **Variance** variance.
**dWeibullgammaCount_mat_Covariates**

*Univariate Weibull Count Probability with gamma and covariate heterogeneity*

---

**Description**

Univariate Weibull Count Probability with gamma and covariate heterogeneity

**Usage**

```r
dWeibullgammaCount_mat_Covariates(
  x, cc, t = 1,
  r, alpha,
  Xcovar, beta,
  logFlag = FALSE,
  jmax = 100L
)
```

**Arguments**

- `x, cc, t, logFlag, jmax`  
  TODO keywords internal
- `r`  
  numeric shape of the gamma distribution
- `alpha`  
  numeric rate of the gamma distribution
- `Xcovar`  
  matrix covariates value
- `beta`  
  numeric vector of slopes

---

**evCount_conv_bi**  
*Expected value and variance of renewal count process*

---

**Description**

Compute numerically expected values and variances of renewal count processes.
evCount_conv_bi

Usage

evCount_conv_bi(
  xmax,
  distPars,
  dist = c("weibull", "gamma", "gengamma", "burr"),
  method = c("dePril", "direct", "naive"),
  nsteps = 100,
  time = 1,
  extrap = TRUE
)

evCount_conv_user(
  xmax,
  distPars,
  extrapolPars,
  survR,
  method = c("dePril", "direct", "naive"),
  nsteps = 100,
  time = 1,
  extrap = TRUE
)

Arguments

  xmax       unsigned integer maximum count to be used.
  distPars   TODO
  dist       TODO
  method     TODO
  nsteps     unsigned integer, number of steps used to compute the integral.
  time       double, time at which to compute the probabilities. Set to 1 by default.
  extrapol   logical, if TRUE, Richardson extrapolation will be applied to improve accuracy.
  extrapolPars ma::vec of length 2. The extrapolation values.
  survR      function, user supplied survival function; should have signature function(t, distPars), where \( t \) is a positive real number (the time where the survival function is evaluated) and distPars is a list of distribution parameters. It should return a double value.

Details

evCount_conv_bi computes the expected value and variance of renewal count processes for the built-in distributions of inter-arrival times.
evCount_conv_user computes the expected value and variance for a user specified distribution of the inter-arrival times.

Value

  a named list with components "ExpectedValue" and "Variance".
Examples

```r
pwei_user <- function(tt, distP) {
    alpha <- exp(-log(distP["scale"]) / distP["shape"])
    pweibull(q = tt, scale = alpha, shape = distP["shape"],
             lower.tail = FALSE)
}

## ev convolution Poisson count
lambda <- 2.56
beta <- 1
distPars <- list(scale = lambda, shape = beta)
evbi <- evCount_conv_bi(20, distPars, dist = "weibull")
ev <- evCount_conv_user(20, distPars, c(2, 2), pwei_user, "dePril")
c(evbi["ExpectedValue"], lambda)
c(evu["ExpectedValue"], lambda)
c(evbi["Variance"], lambda)
c(evu["Variance"], lambda)

## ev convolution weibull count
lambda <- 2.56
beta <- 1.35
distPars <- list(scale = lambda, shape = beta)
evbi <- evCount_conv_bi(20, distPars, dist = "weibull")
ev <- evCount_conv_user(20, distPars, c(2.35, 2), pwei_user, "dePril")
x <- 1:20
px <- dCount_conv_bi(x, distPars, "weibull", "dePril",
                      nsteps = 100)
ev <- sum(x * px)
var <- sum(x^2 * px) - ev^2
```

Description

Fertility data analysed by Winkelmann(1995). The data comes from the second (1985) wave of German Socio-Economic Panel. The sample is formed by 1,243 women aged 44 or older in 1985. The response variable is the number of children per woman and explanatory variables are described in more details below.
Usage

fertility

Format

A data frame with 9 variables (5 factors, 4 integers) and 1243 observations:

- children: integer; response variable: number of children per woman (integer).
- german: factor; is the mother German? (yes or no).
- years_school: integer; education measured as years of schooling.
- voc_train: factor; vocational training? (yes or no)
- university: factor; university education? (yes or no)
- religion: factor; mother’s religion: Catholic, Protestant, Muslim or Others (reference).
- rural: factor; rural (yes or no?)
- year_birth: integer; year of birth (last 2 digits)
- age_marriage: integer; age at marriage

For further details, see Winlemann(1995).

References


---

**football**

*Football data*

Description


Usage

football

Format

A data frame with 6 columns and 1104 observations:

- seasonId: integer season identifier (year of the first month of competition).
- gameDate: POSIXct game date and time.
- homeTeam, awayTeam: character home and away team name.
- homeTeamGoals, awayTeamGoals: integer number of goals scored by the home and the away team.

Details

The data were collected from [https://www.football-data.co.uk/](https://www.football-data.co.uk/) and slightly formatted and simplified.
frequency_plot

Plot a frequency chart

Description

Plot a frequency chart to compare actual and predicted values.

Usage

frequency_plot(count_labels, actual, pred, colours)

Arguments

count_labels character, labels to be used.
actual numeric, the observed probabilities for the different count specified in count_labels.
pred data.frame of predicted values. Should have the same number of rows as actual and one column per model. The columns’ names will be used as labels for the different models.
colours character vector of colour codes with length ncol(pred) + 2.

Details

In order to compare actual and fitted values, a barchart plot is created. It is the user’s responsibility to provide the count, observed and fitted values.

getParNames

Return the names of distribution parameters

Description

Return the names of the parameters of a count distribution.

Usage

getParNames(dist, ...)

Arguments

dist character, name of the distribution.
...
parameters to pass when dist == "custom".

Value

character vector with the names of the distribution parameters.
predict.renewal

Predict method for renewal objects

Description

Compute predictions from renewal objects.

Usage

## S3 method for class 'renewal'
predict(
  object,
  newdata = NULL,
  type = c("response", "prob"),
  se.fit = FALSE,
  terms = NULL,
  na.action = na.pass,
  time = 1,
  ...
)

Arguments

object Object of class inheriting from "lm"
newdata An optional data frame in which to look for variables with which to predict. If omitted, the fitted values are used.
type type of prediction. If equal to "response", give the mean probability associated with the individual covariates. If "prob", give the probability of the observed count.
se.fit A switch indicating if standard errors are required.
terms If type = "terms", which terms (default is all terms), a character vector.
na.action function determining what should be done with missing values in newdata. The default is to predict NA.
time TODO...

Examples

fn <- system.file("extdata", "McShane_Wei_results_boot.RDS", package = "Countr")
object <- readRDS(fn)
data <- object$data
## old data
predOld.response <- predict(object, type = "response", se.fit = TRUE)
predOld.prob <- predict(object, type = "prob", se.fit = TRUE)

## newData (extracted from old Data)
renewalCoef <- head(data)

predNew.response <- predict(object, newdata = newData,
type = "response", se.fit = TRUE)
predNew.prob <- predict(object, newdata = newData,
type = "prob", se.fit = TRUE)

cbind(head(predOld.response$values),
       head(predOld.response$se$scale),
       head(predOld.response$se$shape),
       predNew.response$values,
       predNew.response$se$scale,
       predNew.response$se$shape)

cbind(head(predOld.prob$values),
       head(predOld.prob$se$scale),
       head(predOld.prob$se$shape),
       predNew.prob$values,
       predNew.prob$se$scale,
       predNew.prob$se$shape)

renewalCoef          Get named vector of coefficients for renewal objects

Description

Get named vector of coefficients for renewal objects.

Usage

renewalCoef(object, ...)

Arguments

object

an object, there are methods for several classes, see Details.

... further arguments to be passed to renewalNames, usually something like target = "weibull".

Details

This is a convenience function for constructing named vector of coefficients for renewal count models. Such vectors are needed, for example, for starting values in the model fitting procedures. The simplest way to get a suitably named vector is to take the coefficients of a fitted model but if the fitting procedure requires initial values, this is seemingly a circular situation.

The overall idea is to take coefficients specified by object and transform them to coefficients suitable for a renewal count model as specified by the arguments ". . . " . The provided methods eliminate the need for tedious manual preparation of such vectors and in the most common cases allow the user to do this in a single line.

The default method extracts the coefficients of object using
renewalCoefList

co <- coef(object) (an error is raised if this fails). It prepares a named numeric vector with names requested by the arguments in "..." and assigns co to the first length(co) elements of the prepared vector. The net effect is that the coefficients of a model can be initialised from the coefficients of a nested model. For example a Poisson regression model can be used to initialise a Weibull count model. Of course the non-zero shape parameter(s) of the Weibull model need to be set separately.

If object is from class glm, the method is identical to the default method.

If object is from class renewalCoefList, its elements are simply concatenated in one long vector.

References


See Also

renewalNames

renewalCoefList Split a vector using the prefixes of the names for grouping

Description

Split a vector using the prefixes of the names for grouping.

Usage

renewalCoefList(coef)

Arguments

coe a named vector

Details

The names of the coefficients of renewal regression models are prefixed with the names of the parameters to which they refer. This function splits such vectors into a list with one component for each parameter. For example, for a Weibull renewal regression model this will create a list with components "scale" and "shape".

This is a convenience function allowing users to manipulate the coefficients related to a parameter more easily. renewalCoef can convert this list back to a vector.

See Also

renewalNames, renewalCoef
renewalCount

Fit renewal count processes regression models

Description
Fit renewal regression models for count data via maximum likelihood.

Usage
renewalCount(
  formula, data, subset, na.action, weights, offset, dist = c("weibull", "weibullgam", "custom", "gamma", "gengamma"), anc = NULL, convPars = NULL, link = NULL, time = 1, control = renewal.control(...), customPars = NULL, seriesPars = NULL, weiMethod = NULL, computeHessian = TRUE, standardise = FALSE, standardise_scale = 1, model = TRUE, y = TRUE, x = FALSE, ...
)

Arguments

formula    a formula object. If it is a standard formula object, the left hand side specifies the response variable and the right hand sides specifies the regression equation for the first parameter of the conditional distribution. formula can also be used to specify the ancilliary regressions, using the operator ‘|’, see Details.

data, subset, na.action, weights, offset arguments controlling formula processing via model.frame.

optional numeric vector of weights.

optional numeric vector with an a priori known component to be included in the linear predictor of the count model. Currently not used.
dist character, built-in distribution to be used as the inter-arrival time distribution or "custom" for a user defined distribution, see Details. Currently the built-in distributions are "weibull", "weibullgam", "gamma", "gengamma" (generalized-gamma) and "burr".

anc a named list of formulas for ancillary regressions, if any, otherwise NULL. The formulas associated with the (exact) parameter names are used. The left-hand sides of the formulas in anc are ignored.

convPars a list of convolution parameters arguments with slots nsteps, extrap and convMethod, see dCount_conv_bi. If NULL, default parameters will be applied.

link named list of character strings specifying the name of the link functions to be used in the regression. If NULL, the canonical link function will be used, i.e, log if the parameter is supposed to be positive, identity otherwise.

time numeric, time at which the count is observed; default to unity (1).

control a list of control arguments specified via renewal.control.

customPars list, user inputs if dist = "custom", see details.

seriesPars list, series expansion input parameters with slots terms (number of terms in the series expansion), iter (number of iteration in the accelerated series expansion algorithm) and eps (tolerance in the accelerated series expansion algorithm). Only used if dist = "weibull" and weiMethod = c("series_mat", "series_acc").

weiMethod character, computation method to be used if dist = "weibull" or "weibullgam", see dWeibullCount and dWeibullgammaCount.

computeHessian logical, should the hessian (and hence the covariance matrix) be computed numerically at the fitted values.

standardise logical should the covariates be standardised using standardize::standardize() function.

standardise_scale numeric the desired scale for the covariates; default to 1

model, y, x logicals. If TRUE the corresponding components of the fit (model frame, response, model matrix) are returned.

... arguments passed to renewal.control in the default setup.

Details

renewal re-uses design and functionality of the basic R tools for fitting regression model (lm, glm) and is highly inspired by hurdle() and zeroInfl() from package pscl. Package Formula is used to handle formulas.

Argument formula is a formula object. In the simplest case its left-hand side (lhs) designates the response variable and the right-hand side the covariates for the first parameter of the distribution (as reported by getParNames). In this case, covariates for the ancilliary parameters are specified using argument anc.

The ancilliary regressions, can also be specified in argument formula by adding them to the right-hand side, separated by the operator '|'. For example Y | shape ~ x + y | z can be used in place of the pair Y ~ x + y and anc = list(shape = ~z). In most cases, the name of the second parameter
can be omitted, which for this example gives the equivalent \( Y \sim x + y \mid z \). The actual rule is that if the parameter is missing from the left-hand side, it is inferred from the default parameter list of the distribution.

As another convenience, if the parameters are to to have the same covariates, it is not necessary to repeat the rhs. For example, \( Y \mid \text{shape} \sim x + y \) is equivalent to \( Y \mid \text{shape} \sim x + y \mid x + y \). Note that this is applied only to parameters listed on the lhs, so \( Y \sim x + y \) specifies covariates only for the response variable and not any other parameters.

Distributions for inter-arrival times supported internally by this package can be chosen by setting argument "dist" to a suitable character string. Currently the built-in distributions are "weibull", "weibullgam", "gamma", "gengamma" (generalized-gamma) and "burr".

Users can also provide their own inter-arrival distribution. This is done by setting argument "dist" to "custom", specifying the initial values and giving argument customPars as a list with the following components:

- `parNames` character, the names of the parameters of the distribution. The location parameter should be the first one.
- `survivalFct` function object containing the survival function. It should have signature function(t, distPars) where t is the point where the survival function is evaluated and distPars is the list of the distribution parameters. It should return a double value.
- `extrapolFct` function object computing the extrapolation values (numeric of length 2) from the value of the distribution parameters (in distPars). It should have signature function(distPars) and return a numeric vector of length 2. Only required if the extrapolation is set to TRUE in convPars.

Some checks are done to validate customPars but it is user’s responsibility to make sure the functions have the appropriate signatures.

**Note:** The Weibull-gamma distribution is an experimental version and should be used with care! It is very sensitive to initial values and there is no guarantee of convergence. It has also been reparameterized in terms of \((1/r, 1/\alpha, c)\) instead of \((r, \alpha, c)\), where \(r\) and \(\alpha\) are the shape and scale of the gamma distribution and \(c\) is the shape of the Weibull distribution.

(2017-08-04(Georgi) experimental feature): probability residuals in component 'probResiduals'. I also added type 'prob' to the method for residuals() to extract them. probResiduals[i] is currently \(1 - \text{Prob}(Y[i] \text{ given the covariates})\). "one minus", so that values close to zero are "good". On its own this is probably not very useful but when comparing two models, if one of them has mostly smaller values than the other, there is some reason to claim that the former is superior. For example (see below), gamModel < poisModel in 3:1

**Value**

An S3 object of class "renewal", which is a list with components including:

- `coefficients` values of the fitted coefficients.
- `residuals` vector of weighted residuals \(\omega \ast (\text{observed} - \text{fitted})\).
- `fitted.values` vector of fitted means.
- `optim` data.frame output of optimx.
- `method` optimisation algorithm.
control  the control arguments, passed to optimx.
start  starting values, passed to optimx.
weights  weights to apply, if any.
n  number of observations (with weights > 0).
iterations  number of iterations in the optimisation algorithm.
execTime  duration of the optimisation.
loglik  log-likelihood of the fitted model.
df.residual  residuals’ degrees of freedom for the fitted model.
vcoc  covariance matrix of all coefficients, computed numerically from the hessian at the fitted coefficients (if computeHessian is TRUE).
dist  name of the inter-arrival distribution.
link  list, inverse link function corresponding to each parameter in the inter-arrival distribution.
converged  logical, did the optimisation algorithm converge?
data  data used to fit the model.
formula  the original formula.
call  the original function call.
anc  named list of formulas to model regression on ancillary parameters.
score_fct  function to compute the vector of scores defined in Cameron(2013) equation 2.94.
convPars  convolution inputs used.
customPars  named list, user passed distribution inputs, see Details.
time  observed window used, default is 1.0 (see inputs).
model  the full model frame (if model = TRUE).
y  the response count vector (if y = TRUE).
x  the model matrix (if x = TRUE).

References


Examples

```r
## Not run:
## may take some time to run depending on your CPU
data(football)
wei = renewalCount(formula = homeTeamGoals ~ 1,
data = football, dist = "weibull", weiMethod = "series_acc",
computeHessian = FALSE, control = renewal.control(trace = 0,
method = "nlminb"))

## End(Not run)
```
renewalNames  

Get names of parameters of renewal regression models

Description
Get names of parameters of renewal regression models

Usage
renewalNames(object, ...)

Arguments
- object: an object.
- ...: further arguments.

Details
renewalNames gives the a character vector of names of parameters for renewal regression models. There are two main use scenarios: renewalNames(object, target = "dist") and renewalNames(object, ...). In the first scenario target can be a count distribution, such as "weibull" or a parameter name, such as shape. In this case renewalNames transforms coefficient names of object to those specified by target. In the second scenario the argument list is the same that would be used to call renewalCount. In this case renewalNames returns the names that would be used by renewalCount for the coefficients of the fitted model.

See Also
renewalCoefList, renewalCoef

renewal_methods  

Methods for renewal objects

Description
Methods for renewal objects.

Usage
## S3 method for class 'renewal'
coef(object, ...)

## S3 method for class 'renewal'
vcov(object, ...)

## S3 method for class 'renewal'
residuals(object, type = c("pearson", "response", "prob"), ...)

## S3 method for class 'renewal'
residuals_plot(object, type = c("pearson", "response", "prob"), ...)

## S3 method for class 'renewal'
fitted(object, ...)

## S3 method for class 'renewal'
confint(
  object,
  parm,
  level = 0.95,
  type = c("asymptotic", "boot"),
  bootType = c("norm", "bca", "basic", "perc"),
  ...
)

## S3 method for class 'renewal'
summary(object, ...)

## S3 method for class 'renewal'
print(x, digits = max(3, getOption("digits") - 3), ...)

## S3 method for class 'summary.renewal'
print(
  x,
  digits = max(3, getOption("digits") - 3),
  width = getOption("width"),
  ...
)

## S3 method for class 'renewal'
model.matrix(object, ...)

## S3 method for class 'renewal'
logLik(object, ...)

## S3 method for class 'renewal'
nobs(object, ...)

## S3 method for class 'renewal'
extraitAIC(fit, scale, k = 2, ...)

## S3 method for class 'renewal'
addBootSampleObject(object, ...)
## S3 method for class 'renewal'
df.residual(object, ...)

### Arguments

- **object**: an object from class "renewal".
- **...**: further arguments for methods.
- **type, parm, level, bootType, x, digits**: see the corresponding generics and section ‘Details’.
- **width**: numeric width length.
- **fit, scale, k**: same as in the generic.

### Details

Objects from class "renewal" represent fitted count renewal models and are created by calls to "renewalCount()". There are methods for this class for many of the familiar functions for interacting with fitted models.

### Examples

```r
fn <- system.file("extdata", "McShane_Wei_results_boot.RDS", package = "Countr")
object <- readRDS(fn)
class(object) # "renewal"

coef(object)
vcov(object)

## Pearson residuals: rescaled by sd
head(residuals(object, "pearson"))

## response residuals: not rescaled
head(residuals(object, "response"))

head(fitted(object))

## loglik, nobs, AIC, BIC
cc(loglik = as.numeric(logLik(object)), nobs = nobs(object),
   AIC = AIC(object), BIC = BIC(object))

asym <- se.coef(object, "asymptotic")
boot <- se.coef(object, "boot")
cbind(asym, boot)

## CI for coefficients
asym <- confint(object, type = "asymptotic")

## Commenting out for now, see the nite in the code of confint.renewal():
# boot <- confint(object, type = "boot", bootType = "norm")

list(asym = asym, boot = boot)
summary(object)
print(object)
```

## See Also

- [renewal_methods](#)
- [renewal_methods](#)
residuals_plot

Method to visualise the residuals

Description

A method to visualise the residuals

Usage

residuals_plot(object, type, ...)

Arguments

object object returned by one of the count modeling functions.
type character type of residuals to be used.
... further arguments for methods.

se.coef

Extract Standard Errors of Model Coefficients

Description

Extract standard errors of model coefficients from objects returned by count modeling functions.

Usage

se.coef(object, parm, type, ...)

## S3 method for class 'renewal'
se.coef(object, parm, type = c("asymptotic", "boot"), ...)

Arguments

object an object returned by one of the count modeling functions.
parm parameter's name or index.
type type of standard error: asymptotic normal standard errors ("asymptotic") or bootstrap ("boot").
... further arguments for methods.

Details

The method for class "renewal" extracts standard errors of model coefficients from objects returned by renewal. When bootstrap standard error are requested, the function checks for the bootstrap sample in object. If it is not found, the bootstrap sample is created and a warning is issued. Users can choose between asymptotic normal standard errors (asymptotic) or bootstrap (boot).
surv

Description

Wrapper to built-in survival functions

Usage

surv(t, distPars, dist)

Arguments

t double, time point where the survival is to be evaluated at.
distPars Rcpp::List with distribution specific slots, see details.
dist character name of the built-in distribution, see details.

Details

The function wraps all built-in survival distributions. User can choose between the weibull, gamma, gengamma (generalized gamma) and burr (Burr type XII distribution). It is the user responsibility to pass the appropriate list of parameters as follows:

- **weibull** scale (the scale) and shape (the shape) parameters.
- **burr** scale (the scale) and shape1 (the shape1) and shape2 (the shape2) parameters.
- **gamma** scale (the scale) and shape (the shape) parameter.
- **gengamma** mu (location), sigma (scale) and Q (shape) parameters.

Value

a double, giving the value of the survival function at time point t at the parameters’ values.
Examples

```
## weibull
distP <- list(scale = 1.2, shape = 1.16)
alpha <- exp(-log(distP["scale"]) / distP["shape"])
pweibull(q = tt, scale = alpha, shape = distP["shape"],
    lower.tail = FALSE)
surv(tt, distP, "weibull") ## (almost) same

## gamma
distP <- list(shape = 0.5, rate = 1.0 / 0.7)
pgamma(q = tt, rate = distP["rate"], shape = distP["shape"],
    lower.tail = FALSE)
surv(tt, distP, "gamma") ## (almost) same

## generalized gamma
distP <- list(mu = 0.5, sigma = 0.7, Q = 0.7)
flexsurv::pgengamma(q = tt, mu = distP["mu"],
    sigma = distP["sigma"],
    Q = distP["Q"],
    lower.tail = FALSE)
surv(tt, distP, "gengamma") ## (almost) same
```
Index

* datasets
  - fertility, 18
  - football, 19

addBootSampleObject, 3
addBootSampleObject.renewal (renewal_methods), 28

character, 21
chiSq_gof, 3, 4, 6
chiSq_pearson, 3, 5, 5
coef.renewal (renewal_methods), 28
compareToGLM, 6
confint.renewal (renewal_methods), 28
count_table, 7
Countr (Countr-package), 3
Countr-package, 3
CountrFormula, 7
dCount_conv_bi, 8
dCount_conv_loglik_bi, 10
dCount_conv_loglik_user
  (dCount_conv_loglik_bi), 10
dCount_conv_user (dCount_conv_bi), 8
df.residual.renewal (renewal_methods),
  28
dmodifiedCount_bi, 12
dmodifiedCount_user
  (dmodifiedCount_bi), 12
dWeibullCount, 14
dWeibullCount_loglik (dWeibullCount), 14
dWeibullgammaCount_mat_Covariates, 16
evCount_conv_bi, 16
evCount_conv_user (evCount_conv_bi), 16
evWeibullCount (dWeibullCount), 14
extractAIC.renewal (renewal_methods), 28

fertility, 18
fitted.renewal (renewal_methods), 28
football, 19

frequency_plot, 20
getParNames, 20, 25
logLik.renewal (renewal_methods), 28
model.matrix.renewal (renewal_methods),
  28
nobs.renewal (renewal_methods), 28
predict.renewal, 21
print.renewal (renewal_methods), 28
print.summary.renewal
  (renewal_methods), 28
renewal_methods, 4, 28
renewalCoef, 22, 23, 28
renewalCoefList, 23, 23, 28
renewalCount, 3, 24
renewalNames, 23, 28
residuals.renewal (renewal_methods), 28
residuals_plot, 31
residuals_plot.renewal
  (renewal_methods), 28
se.coef, 31
summary.renewal (renewal_methods), 28
surv, 32
vcov.renewal (renewal_methods), 28