

Package ‘mcount’

May 8, 2026

Type Package

Title Marginalized Count Regression Models

Version 1.0.1

Description Implementation of marginalized models for zero-inflated count data. The package provides tools to estimate marginalized count regression models for direct inference on the effect of covariates on the marginal mean of the outcome. The methods include the marginalized zero-inflated Poisson (MZIP) model described in Long et al. (2014) <[doi:10.1002/sim.6293](https://doi.org/10.1002/sim.6293)> and the marginalized zero- and N-inflated binomial (MZNIB) model, which extends marginalized modeling to fractional count outcomes with boundary inflation at zero and the upper limit.

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Encoding UTF-8

LazyData true

Depends R (>= 4.0.0)

Imports bbmle, boot, boot.pval, rootSolve, robustbase, stats

NeedsCompilation no

RoxygenNote 7.3.3

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Repository CRAN

Date/Publication 2026-04-21 22:22:11 UTC

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dat.pal	<i>Promoting Adherence for Life (PAL) study dataset</i>
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Description

A dataset from the Promoting Adherence for Life (PAL) study, as reported in Huh, Flaherty, and Simoni (2012) and Simoni et al. (2009). The PAL study was a 2×2 factorial trial that evaluated peer support and text reminders for promoting HIV antiretroviral adherence.

Usage

dat.pal

Format

A data frame with variables including:

id Participant identifier.

tx A factor variable specifying the intervention group with the following categories: "CTRL" = Control (Standard of Care), "PEER" = Peer support only, "TXTS" = Text messages only, and "BOTH" = Peer support plus text messages.

doses0 Number of doses taken in the past 3 days, at baseline.

doses3 Number of doses taken in the past 3 days, at post-intervention.

totaldoses Number of total prescribed doses.

Source

PAL study

References

Huh, D., Flaherty, B. P., & Simoni, J. M. (2012). Optimizing the analysis of adherence interventions using logistic generalized estimating equations. *AIDS and Behavior*, *16*(2), 422–431. doi:10.1007/s1046101199555

Simoni, J. M., Huh, D., Frick, P. A., Pearson, C. R., Andrasik, M. P., Dunbar, P. J., & Hooton, T. M. (2009). Peer support and pager messaging to promote antiretroviral modifying therapy in Seattle: A randomized controlled trial. *Journal of Acquired Immune Deficiency Syndromes*, *52*(4), 465–473. doi:10.1097/QAI.0b013e3181b9300c

`dat.pfi`*Personalized Feedback Intervention (PFI) example dataset*

Description

A dataset from White, Mun, and Morgan (2008), which is also described in Mun et al. (2015, 2022).

Usage`dat.pfi`**Format**

A data frame with 194 rows and 5 variables:

m0 Number of standard alcohol drinks consumed at baseline.

int_PF Indicator for receiving personalized feedback intervention (PFI): 1 = received PFI, 0 = did not receive PFI.

year_new Indicator for first-year college student status: 1 = first-year student, 0 = otherwise.

race_new Indicator for race: 1 = White, 0 = non-White.

y Number of standard alcohol drinks consumed at post-intervention; the response variable.

Source

White et al. (2008)

References

White, H. R., Mun, E.-Y., & Morgan, T. J. (2008). Do brief personalized feedback interventions work for mandated students or is it just getting caught that works? *Psychology of Addictive Behaviors*, 22(1), 107–116. doi:10.1037/0893164X.22.1.107

Mun, E. Y., De La Torre, J., Atkins, D. C., White, H. R., Ray, A. E., Kim, S. Y., ... & The Project INTEGRATE Team. (2015). Project INTEGRATE: An integrative study of brief alcohol interventions for college students. *Psychology of Addictive Behaviors*, 29(1), 34–48. doi:10.1037/adb0000047

Mun, E.-Y., Zhou, Z., Huh, D., Tan, L., Li, D., Tanner-Smith, E. E., Walters, S. T., & Larimer, M. E. (2022). Brief alcohol interventions are effective through six months: Findings from marginalized zero-inflated Poisson and negative binomial models in a two-step IPD meta-analysis. *Prevention Science*. doi:10.1007/s11121022014201

mzip

Estimating Marginalized Zero-inflated Poisson Models

Description

Fit marginalized zero-inflated Poisson models for zero-inflated count data via maximum likelihood estimation.

Usage

```
mzip(formula, data)
```

Arguments

formula	an object of class "formula" (or one that can be coerced to that class): a symbolic description of the model to be fitted. A typical formula has the form $\text{response} \sim \text{terms}$ where response is the count response vector and terms is a series of terms that predict response. For example, $\text{formula} = y \sim x1 + x2 + x3$. Do not write intercept in the formula; intercept will be automatically added in model fitting.
data	a data frame containing variables in the model.

Details

Function returns an object of class "mle2" from **bbmle** R package. Apply `summary` function to the resulting object from the function to obtain more estimation information.

Value

`mzip` returns an object of class "mzip". The fitted model object contains the estimated coefficients and other information about the fitted model.

The function `summary` (i.e., `summary.mzip`) can be used to obtain or print a summary of the results.

Suffix `_zero` corresponds to the parameters associated with the structural zero rate part of a model.

Suffix `_mean` corresponds to the parameters associated with the overall mean, which evaluate the effects of covariates on the overall mean.

References

Long, D. L., Preisser, J. S., Herring, A. H., & Golin, C. E. (2014). A marginalized zero-inflated Poisson regression model with overall exposure effects. *Statistics in Medicine*, 33(29), 5151-5165.

Examples

```

head(dat.pfi)

#Fit a marginalized zero-inflated Poisson model
res = mzip(formula = y ~ m0 + int_PF + year_new + race_new, data = dat.pfi)

#Obtain estimation results
summary(res)

```

mznib	<i>Estimating Marginalized Zero- and N-inflated Binomial (MZNIB) models</i>
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Description

Fit MZNIB regression models for fractional count data with boundary inflation at zero and the upper limit with bootstrapped standard errors.

Usage

```

mznib(
  formula,
  data,
  N_i,
  initial_value = "auto",
  initial_value_alpha = "auto",
  R = 1000,
  ncpus = 1,
  optim_method = "L-BFGS-B",
  parallel = "no",
  seed = NULL,
  test_method = "perc"
)

```

Arguments

formula	A model formula.
data	A data frame containing variables in the model.
N_i	The maximum value that i-th subject can take (vector).
initial_value	Starting values for estimating the coefficients of the zero- and N-inflated binomial (ZNIB) model, which is used as the "working model" from which the marginalized coefficients are derived. The marginalized coefficients are derived from these initial working estimates from the ZINB. This can be specified manually (i.e., a vector whose length is the number of regression coefficients specified in "formula" (+1 for the intercept) and multiplied by 3). The starting values can also be estimated automatically using GLM by specifying "auto", which we recommend.

<code>initial_value_alpha</code>	Starting values for estimating the marginalized coefficients, with length equal to the number of regression coefficients specified in "formula" +1 for the intercept. The starting values can also be estimated automatically using GLM (= "auto"), which we recommend.
<code>R</code>	The number of bootstrapped replications for estimating standard errors and confidence intervals. A higher number of replications improves precision.
<code>ncpus</code>	The number of CPUs to use (>1 for parallel processing)
<code>optim_method</code>	The maximum-likelihood optimizer used to estimate the initial ZINB estimates from which the marginalized MZNIB estimates are derived. We recommend specifying "L-BFGS-B".
<code>parallel</code>	The type of parallel processing used, if any. Options include "multicore" (MacOS and Unix-based systems), "snow" (Windows systems), or "no" for single-core processing.
<code>seed</code>	A numeric seed number so that the results are reproducible. The number of CPUs specified in the <code>ncpus</code> argument must also be kept the same for exact reproduction of results.
<code>test_method</code>	The method used to estimate confidence intervals and test statistical significance of the marginalized coefficients. The default is "perc" which uses the percentile-based confidence intervals and corresponding P-values. Robust, normal approximation confidence intervals and P-values can be specified using "MCD", which uses the minimum covariance determinant method.

Value

An object of class "mznib", which contains the fitted MZNIB model and has the following components:

coef A data frame with the coefficient estimates and associated standard errors, confidence intervals, and p-values.

alpha_estimates A matrix with the coefficient estimates from each bootstrap replication.

convergence A logical value indicating whether the model fit for the original data converged.

bootobj The bootstrap object containing the bootstrap results.

call The original function call.

formula The original regression formula.

R A scalar indicating the number of bootstrap replications.

test_method A character string indicating the method used to estimate the confidence intervals and test statistical significance.

The function summary (i.e., `summary.mznib`) can be used to obtain or print a summary of the results.

Examples

```
data("dat.pal", package = "mcount")

# Prepare covariates
```

```
dat.pal$doses0z <- as.numeric(scale(dat.pal$doses0))
dat.pal$tx_peer <- as.integer(dat.pal$tx == "PEER")
dat.pal$tx_txts <- as.integer(dat.pal$tx == "TXTS")
dat.pal$tx_both <- as.integer(dat.pal$tx == "BOTH")

# Fit the MZNIB model
fit <- mznib(
  doses3 ~ doses0z + tx_peer + tx_txts + tx_both,
  data = dat.pal,
  N_i = dat.pal$totaldoses,
  initial_value = "auto",
  initial_value_alpha = "auto",
  R = 150,
  ncpus = 1,
  parallel = "no"
)

summary(fit)
```

print.mzip

Print method for mzip objects

Description

Print method for mzip objects

Usage

```
## S3 method for class 'mzip'
print(x, ...)
```

Arguments

x A fitted mzip object.
... Additional arguments passed to print().

print.summary.mznib

Print method for summary.mznib objects

Description

Print method for summary.mznib objects

Usage

```
## S3 method for class 'summary.mznib'
print(x, ...)
```

Arguments

x A summary.mznib object.
 ... Additional arguments (not used).

summary.mzip	<i>Summary method for mzip objects</i>
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Description

Summary method for mzip objects

Usage

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

Arguments

object A fitted mzip object.
 ... Additional arguments passed to `bbmle::summary()`.

Value

A summary object from `bbmle::summary()`.

summary.mznib	<i>Summary method for mznib objects</i>
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Description

Summary method for mznib objects

Usage

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

Arguments

object A fitted mznib object.
 ... Additional arguments (not used).

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Value

An object of class "summary.mznib".

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