

# Package ‘BASiCStan’

May 16, 2024

**Title** Stan implementation of BASiCS

**Version** 1.6.0

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**Description** Provides an interface to infer the parameters of BASiCS using the variational inference (ADVI), Markov chain Monte Carlo (NUTS), and maximum a posteriori (BFGS) inference engines in the Stan programming language. BASiCS is a Bayesian hierarchical model that uses an adaptive Metropolis within Gibbs sampling scheme. Alternative inference methods provided by Stan may be preferable in some situations, for example for particularly large data or posterior distributions with difficult geometries.

**License** GPL-3

**Encoding** UTF-8

**VignetteBuilder** knitr

**Roxygen** list(markdown = TRUE)

**RoxygenNote** 7.2.1

**Biarch** true

**Depends** R (>= 4.2), BASiCS, rstan (>= 2.18.1)

**Imports** methods, glmGamPoi, scran, scuttle, stats, utils,  
SingleCellExperiment, SummarizedExperiment, Rcpp (>= 0.12.0),  
RcppParallel (>= 5.0.1), rstantools (>= 2.1.1)

**LinkingTo** BH (>= 1.66.0), Rcpp (>= 0.12.0), RcppEigen (>= 0.3.3.3.0),  
RcppParallel (>= 5.0.1), rstan (>= 2.18.1), StanHeaders (>= 2.18.0)

**SystemRequirements** GNU make

**biocViews** ImmunoOncology, Normalization, Sequencing, RNASeq, Software,  
GeneExpression, Transcriptomics, SingleCell,  
DifferentialExpression, Bayesian, CellBiology

**URL** <https://github.com/Alanocallaghan/BASiCStan>

**BugReports** <https://github.com/Alanocallaghan/BASiCStan/issues>

**Suggests** testthat (>= 3.0.0), knitr, rmarkdown

**Config/testthat/edition** 3

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BASiCStan-package      *The 'BASiCStan' package.*

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## Description

Provides an interface to infer the parameters of BASiCS using the variational inference (ADVI), Markov chain Monte Carlo (NUTS), and maximum a posteriori (BFGS) inference engines in the Stan programming language. BASiCS is a Bayesian hierarchical model that uses an adaptive Metropolis within Gibbs sampling scheme. Alternative inference methods provided by Stan may be preferable in some situations, for example for particularly large data or posterior distributions with difficult geometries. See also [BASiCS\\_MCMC](#)

## References

- Stan Development Team (2020). RStan: the R interface to Stan. R package version 2.21.2. <https://mc-stan.org>
- Vallejos, Marioni and Richardson (2015). PLoS Computational Biology. <https://doi.org/10.1371/journal.pcbi.1004333>.
- Vallejos, Richardson and Marioni (2016). Genome Biology. <https://doi.org/10.1186/s13059-016-0930-3>
- Eling et al (2018). Cell Systems. <https://doi.org/10.1016/j.cels.2018.06.011>

BASiCStan

*Stan implementation of BASiCS.***Description**

The stan programming language enables the use of MAP, VB, and HMC inference. Only the regression mode featuring a joint prior between mean and overdispersion parameters is implemented

**Usage**

```
BASiCStan(
  Data,
  Method = c("vb", "sampling", "optimizing"),
  WithSpikes = length(altExpNames(Data)) > 0,
  Regression = TRUE,
  BatchInfo = Data$BatchInfo,
  L = 12,
  PriorMu = c("EmpiricalBayes", "uninformative"),
  NormFactorFun = scan::calculateSumFactors,
  ReturnBASiCS = TRUE,
  Verbose = TRUE,
  ...
)
```

**Arguments**

|               |   |
|---------------|---|
| Data          | SingleCellExperiment object   |
| Method        | Inference method. One of: "vb" for Variational Bayes, "sampling" for Hamiltonian Monte Carlo, "optimizing" for or maximum <i>a posteriori</i> estimation.   |
| WithSpikes    | Do the data contain spike-in genes? See BASiCS for details. When WithSpikes=FALSE, the cell-specific scaling normalisation factors are fixed; use NormFactorFun to specify how size factors should be generated or extracted. |
| Regression    | Use joint prior for mean and overdispersion parameters? Included for compatibility with <a href="#">BASiCS_MCMC</a> , but only TRUE is supported.   |
| BatchInfo     | Vector describing which batch each cell is from.  |
| L             | Number of regression terms (including slope and intercept) to use in joint prior for mu and delta.  |
| PriorMu       | Type of prior to use for mean expression. Default is "EmpiricalBayes", but "uninformative" is the prior used in Eling et al. and previous work.   |
| NormFactorFun | Function that returns cell-specific scaling normalisation factors. See <a href="#">computeSumFactors</a> for details on the default.  |
| ReturnBASiCS  | Should the object be converted into a <a href="#">BASiCS_Chain</a> object?  |
| Verbose       | Should output of the stan commands be printed to the terminal?  |
| ...           | Passed to vb or sampling.   |

**Value**

An object of class `BASiCS_Chain`.

**Examples**

```
library("BASiCS")
sce <- BASiCS_MockSCE(NGenes = 10, NCells = 10)

fit_spikes <- BASiCSStan(sce, tol_rel_obj = 1)

## uses fixed scaling normalisation factors
fit_nospikes <- BASiCSStan(sce, WithSpikes = FALSE, tol_rel_obj = 1)
```

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Stan2BASiCS

*Convert Stan fits to `BASiCS_Chain` objects.*


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**Description**

Convert Stan fits to `BASiCS_Chain` objects.

**Usage**

```
Stan2BASiCS(
  x,
  gene_names = attr(x, "gene_names"),
  cell_names = attr(x, "cell_names"),
  size_factors = attr(x, "size_factors")
)
```

**Arguments**

|                                     |   |
|-------------------------------------|---|
| <code>x</code>                      | A stan object   |
| <code>gene_names, cell_names</code> | Gene and cell names. The reason this argument exists is that by default, stan fit parameters are not named. NOTE: this must be the same order as the data supplied to <code>BASiCSStan</code> . |
| <code>size_factors</code>           | Cell-specific scaling normalisation factors, to be stored as part of the chain object when <code>WithSpikes=FALSE</code> .  |

**Value**

A `BASiCS_Chain` object.

**Examples**

```
library("BASiCS")
sce <- BASiCS_MockSCE(NGenes = 10, NCells = 10)

fit_spikes <- BASiCSStan(sce, ReturnBASiCS = FALSE, tol_rel_obj = 1)
summary(fit_spikes)
```

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