



Bayesian Neural Networks in R: The bnns Package

Swarnendu Chatterjee 
GSK

Abstract

Bayesian Neural Networks (BNNs) combine the flexibility of neural networks with the principled uncertainty quantification of Bayesian methods, making them powerful tools for predictive modeling and decision-making under uncertainty. The bnns package provides an R interface for building and training BNNs using the probabilistic programming capabilities of Stan. With a formula-based interface, customizable priors, and support for various activation and output functions, bnns enables users to model complex relationships in regression and classification tasks. Additionally, the package offers posterior summaries for parameters and predictions, aiding interpretability and probabilistic reasoning. Designed for small to moderately sized datasets, bnns is particularly well-suited for applications in clinical research, finance, and other domains requiring robust uncertainty quantification. This article presents the implementation of the bnns package, its core features, and benchmarking results, highlighting its utility and performance across diverse machine learning tasks.

Keywords: bayesian neural networks, probabilistic modeling, uncertainty quantification, machine learning, R.

1. Introduction

This template demonstrates some of the basic LaTeX that you need to know to create a JSS article.

1.1. Code formatting

In general, don't use Markdown, but use the more precise LaTeX commands instead:

- `Java`
- `plyr`

One exception is inline code, which can be written inside a pair of backticks (i.e., using the Markdown syntax).

If you want to use LaTeX commands in headers, you need to provide a `short-title` attribute. You can also provide a custom identifier if necessary. See the header of Section 2 for example.

2. R code

Can be inserted in regular R markdown blocks.

```
R> x <- 1:10
R> x

[1] 1 2 3 4 5 6 7 8 9 10
```

2.1. Features specific to `rticles`

- Adding short titles to section headers is a feature specific to **rticles** (implemented via a Pandoc Lua filter). This feature is currently not supported by Pandoc and we will update this template if **it is officially supported in the future**.
- Using the `\AND` syntax in the `author` field to add authors on a new line. This is a specific to the `rticles::jss_article` format.

Affiliation:

Swarnendu Chatterjee
GSK
First line
Second line
E-mail: `swarnendu.stat@gmail.com`
URL: `https://posit.co`

Journal of Statistical Software

published by the Foundation for Open Access Statistics

MMMMMM YYYY, Volume VV, Issue II

`doi:10.18637/jss.v000.i00`

<http://www.jstatsoft.org/>

<http://www.foastat.org/>

Submitted: yyyy-mm-dd

Accepted: yyyy-mm-dd