

# Penalized distributed lag linear and non-linear models

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<sup>1</sup>This document is included as a vignette (a L<sup>A</sup>T<sub>E</sub>X document created using the R function `Sweave()`) of the package `dlnm`. It is automatically downloaded together with the package and can be simply accessed through R by typing `vignette("dlnmPenalized")`.

# 1 Preamble

This vignette `DLNMPENALIZED` illustrates the extension of the R package `dlnm` to perform a penalized versions of distributed lag linear (DLMs) and non-linear models (DLNMs). This development is thoroughly described in [Gasparrini et al. \[2017\]](#).

The extension of the DLM/DLNM framework to penalized splines within generalized additive models is implemented by embedding the `dlnm` and `mgcv` packages. The latter is used primarily as a computational engine for the estimation of smoothed exposure-lag-response relationships, and to a some extent as a tool for deriving the parameterization of the basis functions and penalty terms. Specifically, two approaches to penalization are implemented in `dlnm` and described here.

A general overview of functions included in the package, with information on its installation and a brief summary of the DLNM methodology are included in the vignette `DLNMOVERVIEW`, which represents the main documentation of `dlnm`. The user can refer to that vignette for a general introduction to the package.

Please send comments or suggestions and report bugs to [antonio.gasparrini@lshtm.ac.uk](mailto:antonio.gasparrini@lshtm.ac.uk).

# 2 Penalized DLMs and DLNMs

This vignette is under development. For an illustration, refer to [Gasparrini et al. \[2017\]](#) and the R code included as supplementary material that reproduces the examples in the article.

# References

A Gasparrini, F Scheipl, B Armstrong, and M G Kenward. A penalized framework for distributed lag non-linear models. *Biometrics*, (In Press), 2017.