

Motivating Letter of “TensorTest2D: Fitting Generalized Linear Models with Matrix Covariates”

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Dear Editor,

In this manuscript, we present the package **TensorTest2D** for fitting generalized linear models with matrix covariate data. A covariate in matrix form is not rare in practice. For instance, as presented in the examples we gave in the manuscript, patient’s gene expression data measured from different platforms can be arranged in a 2-dimensional table. Pixels of an image of a handwritten digit can be converted and stored as matrix data. Identifying important locations in the table or matrix that relate to a variable of interest can be crucial in scientific discovery.

This package deals with issues regarding estimation and statistical hypothesis testing when regressing a scalar response variable on matrix covariates. In contrast to the existing R packages **MultiwayRegression** and **TRES** which fit similar regression models only to data of a normal response variable, our package also provides a solution to logistic regression and Poisson regression. In the first example we gave, drug sensitivity as a continuous response variable is regressed on gene expression table, so that association between drug sensitivity and gene expressions at particular steps of the central dogma of molecular biology can be identified. In the second example, a binary outcome label, indicating two specific digits, is regressed on handwritten image. Results from data analysis revealed the important locations in an image that can be used to distinguish one label from the other. Additionally, we provide a generic function to visualize and mark out the critical area of the matrix predictor. This function can also be applied to results delivered by other variable selection approaches, e.g., via the LASSO.

We would also like to note the authors’ contributions to the writing of the package **TensorTest2D** and the submitted manuscript. Sheng-Mao Chang and Jung-Ying Tzeng contribute the main ideas and the theoretical proofs for the generalized tensor regression models being implemented in the package and considered in the submitted manuscript. Ping-Yang Chen and Yu-Ting Chen (Mark Chen) are the leading developers of the package and authors of the user manual. Hsing-Ming Chang is majorly involved in interpreting analytical results, drafting, revising and proofreading the submitted manuscript. We also honor Wenbin Lu for providing an improved algorithm for parameter estimation by including him as one of the package authors.

Sincerely yours,

Reference

- Lock, Eric F. 2019. *MultiwayRegression: Perform Tensor-on-Tensor Regression*. <https://CRAN.R-project.org/package=MultiwayRegression>.
- Wang, Wenjing, Jing Zeng, and Xin Zhang. 2020. *TRES: Tensor Regression with Envelope Structure and Three Generic Envelope Estimation Approaches*. <https://CRAN.R-project.org/package=TRES>.