Tutorial: How to use the R scripts to analyse FEA derived data using the intervals' method

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We proposed a new method, named the intervals' method, to analyse data from finite element models in a comparative multivariate framework. The intervals' method consists of a set of variables, each one defined by an interval of stress values. Each variable is expressed as a percentage of the area of the model occupied by those stress values. Afterwards these newly generated variables can be analysed using multivariate methods.

This tutorial was written in order to facilitate the application of this method using the R scripts published in: XXXXXX

Please, when using this method cite the following reference: *Marcé-Nogué, J., De Esteban-Trivigno, S., Püschel, T.A., Fortuny, J., 2017. The intervals method: a new approach to analyse finite element outputs using multivariate statistics. PeerJ 5, e3793. https://doi.org/10.7717/peerj.3793*

1. Before starting

All the files that will be analysed should be placed in the same folder where the R scripts are located. Each one of the FEA models that will be analysed should be store as a single .csv file with the following three rows: 1) element number, 2) area (for planar models) or volume (for 3D models) and 3) stress value associated to that element.

In the provided example there are four .csv files corresponding to four armadillo mandibles that were analysed in the paper where the Intervals' method was introduced for the first time.

2. pre-requisites

1) If you are using Windows, please install Rtools.exe prior to running the examples. https://cran.r-project.org/bin/windows/Rtools/
2) please also install the 'devtools' R package. If you have not installed it yet please run the following command on R: install.packages('devtools').

3. Run the code

1) Run the "01-intervals-method-script" first. It is necessary to define the value of the fixed upper threshold (FTupper) and the number of intervals (NIntervals). In the provided example the values defined by default are fine. This code will save a .csv file "matrix-of-intervals" with the percent data of the intervals for all the models included.
2) Run the "02-intervals-method-pca" to obtain the PCA biplot of your data.
3) Run the "03-intervals-method-convergence" to run the convergence test. We provided the different files for the example in N=5, 10, 15, 25, 50, 75 and 100. When analysing your own data, you will need to create your different .csv files with different number of intervals by changing 'NIntervals' in the previous "01-intervals-method-script" file and then run the script for each one of the cases.