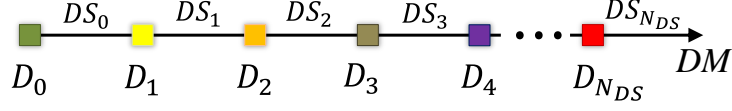


# computeFrag

A code for computing empirical fragility curves based on logistic regression



Graphical representation of damage thresholds,  $D$ , and damage states,  $DS$ .

This code provides an ensemble of the fragility curves and their corresponding confidence bands for a set of mutually exclusive and collectively exhaustive (MECE) damage states ( $DS$ ), where  $DS_i$ :  $i=0, N_{DS}$ . The fragility is defined as the probability of damage  $D$  exceeding the threshold  $D_i$  for damage state  $DS_i$  and is denoted as  $P(D > D_i | IM)$ . The set of damage levels ( $D_i$ ,  $i=0:N_{DS}$ ) mark the thresholds of damage states ( $DS_i$ ).

The parameters of the empirical fragilities associated with different damage level are estimated jointly using Bayesian inference by employing a Markov Chain Monte Carlo Simulation (MCMC) scheme.

The inputs of the code are the following:

**inputFileName**: The filename of a csv file containing two columns, one for the intensity measure and one for the damage state. In this example, it is the file `IM_and_DS.csv`.

**NDS**: The number of the damage states.

**dIM, IM\_max**: The step and the maximum absolute value for the IM vector.

**dvec\_alpha0, dvec\_alpha1**: The increments of the vectors of the two logistic regression parameters.

**confid**: The number of standard deviations defining the confidence interval for the robust fragility (fixed for all the  $DS$ ).

The outputs of the code are the following:

**sample\_theta\_model**:  $N_s=500$  samples generated from the posterior joint probability distribution for logistic fragility model parameters (e.g., a total of 10 parameters for 5  $DS$ , 2 parameters/ $DS$ ) using the MCMC procedure.

**rfragility**: Robust (the mean fragility among the  $N_s=500$  realizations for each  $DS$ ) fragility curve with the row showing the IM vector and a number of columns equal to the number of  $DS$ .

**sfragility**: The standard deviation of the  $N_s=500$  fragility curve samples (the same structure as rfragility). For having the fragility with a confidence, you should do this operation:  $rfragility + confid * sfragility$  (e.g., if  $confid=\pm 1$ , we have 16th and 84th percentiles, if  $confid=\pm 2$ , we have 2nd and 98th percentiles).

**etalMc**: The median of rfragility (i.e., the IM value corresponding to 50% probability from rfragility). It is a vector with its length equal to the number of DS.

**betaIMc**: The equivalent logarithmic standard deviation of the rfragility (i.e., half of the logarithmic distance between IM values corresponding to 84% and 16% probabilities, respectively). It is a vector with its length equal to the number of DS.

To execute the code, run the script computeFrag.py.

Requirements: MATLAB, numpy, pandas