Proposed terminology for conditional spectra and related concepts

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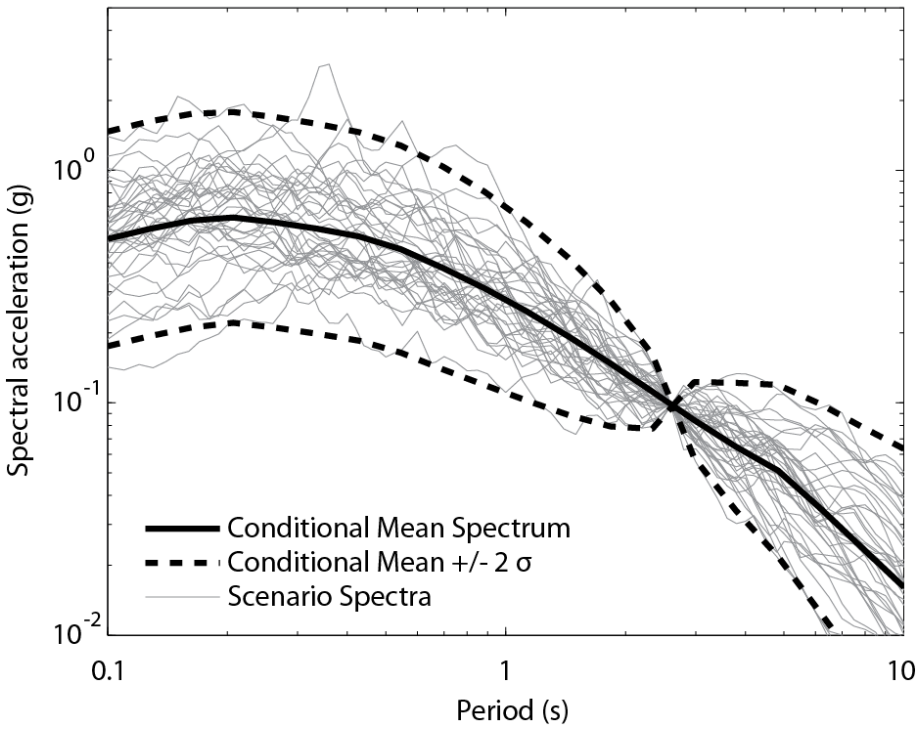
The following is a proposal for terminology to refer to various response spectrum calculations and related ground motions. Basic familiarity with these concepts is assumed, and readers desiring more background should see Baker (2011) or the other references listed below.

Conditional Spectrum (CS)

The Conditional Spectrum is the *probability distribution* of log spectral acceleration (*Sa*) values, conditional on a spectral value at a conditioning period. If we assume that the distribution is multivariate normal (which is generally reasonable), then the Conditional Spectrum is fully described by conditional means, standard deviations and correlations. Visually we can represent this distribution by plotting the mean and +/- one or two standard deviations around the mean, as in the figure below.



Notes regarding use of this term: Abrahamson and Al Atik (2010) coined this term, but represented the CS distribution directly by realizations of the spectra rather than an analytical distribution. Lin et al. (2013) was the first time that the Baker group used "CS" in the manner above; prior to that (e.g., Baker 2011 and Jayaram et al. 2011), we used "conditional mean and variance" or something similar. Bradley (2010) extended the CS to ground motion parameters other than response spectra, and refers to the resulting distribution as a Generalized Conditional Intensity Measure (GCIM).

Conditional Mean Spectrum (CMS)

The CMS is the set of conditional *mean* values of log *Sa*. This is the mean value of the CS distribution, and can be plotted as above.

Notes regarding use of this term: We have used this terminology since Baker and Cornell (2006), and others largely have too. One subtlety that may not be consistent in all literature is that the "mean spectrum" refers to the mean log *Sa* values, even though we then often take the exponential of this spectrum in order to plot or tabulate it in more intuitive units. (The mean values of log *Sa* correspond the median values of *Sa* if *Sa* is lognormally distributed. The fact that a conditional *mean* spectrum corresponds to a *median Sa* creates an opportunity for confusion, but terminology using "mean" was adopted because the CMS calculation explicitly involves calculation of mean log *Sa* values.)

Scenario Spectra and Scenario Ground Motions

Scenario Spectra are *ground motions representing the Conditional Spectra* (e.g., the light grey lines in the figure above). Either the spectral values only, or ground motions associated with those spectra ("Scenario Ground Motions") may be desired, depending upon the application. Probabilistically, Scenario Spectra can be thought of as a realizations from the probability distribution described by the CS. Scenario Spectra can be obtained from Monte Carlo simulation from the CS distribution, or by an some approach that selects spectra of time histories from a database such that they have means, standard deviations and correlations consistent with the CS.

Notes regarding use of this term: Abrahamson and Al Atik (2010) and Abrahamson and Yunatci (2010) use Scenario Spectra in a manner that is similar but not identical to the above. The Baker group has not yet used this terminology in a publication.

References

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