DOI	https://doi.org/10.1002/eqe.3346
Title	Entropy-based intensity measure selection for site-specific probabilistic seismic risk assessment
Background	
Why this paper? How'd you find it?	As probabilistic modeling becomes more popular in engineering, it's important to make predictions on meaningful features. IM selection has always been a module in the PBEE framework, and any model that predicts performance on a ground motion has to be founded on a good IM predictor. I found this while looking through Jamie Padgett's work.
Study Objective	To evaluate a series of IMs using an entropy-based criterion
Intended gaps to fill	Conventional evaluation of IMs are based on efficiency, i.e. low dispersion of error when regressing demand on IM. The authors argue this is not holistic because it does not take into account dispersion of the IM itself (for PSHA, you need to estimate an unknown IM from site conditions) nor the dispersion of the demand itself. The argument extends that efficiency is simply dispersion of demand conditioned on IM. Entropy of demand, on the other hand, is unconditioned dispersion.
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Journal / Field	Earthquake Engineering and Structural Dynamics
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Historical Context	
Relationship to SEMM	Intensity measures as discussed in CE 227, spectral accelerations as discussed in CE 225
Methods	
Given:	A series of scenario earthquakes
Find:	Intensity measure with the lowest entropy of demand
Experimental Design	1) Run analysis of a scenario earthquake 2) Calculate the vectors of IM across many periods 3) Train prediction model for demand given IM 4) Test prediction model by taking random IMs (over likely distribution using GMPE) and predicting demand 5) Evaluate entropy of the demand 6) Repeat for various scenarios
Test Subjects	A concrete girder bridge and a steel girder bridge IMs: spectral acceleration (Sa) at one period, Sa averaged over a period range centering a period, a vector of 3 Sa
Results	
Baseline for comparison	Entropy of error in the demand prediction model
Metric for comparison	Entropy of the demand prediction model
Difference from baseline	Entropy of the demand should include dispersion of the IM itself along with the prediction model's
Conclusions	
Authors'	Sa_avg outperforms all other IMs, even the vector-based Sa. Compared to Sa(fixed), Sa(avg) contains more info. Compared to vector Sa, Sa_avg does not aggregate uncertainty in the IM itself because it is only one value. Sa_vector does better when just considering error of prediction. Vector IMs most suitable when dealing with structures with multiple significant periods. Sa_avg does not outperform by much when considering risk estimate (after aggregating demand and transforming to risk/costs). Selection of IM still greatly affects risk/cost estimates
Yours	In the veins of finding proper features, if IM uncertainty is significant, then GMPEs is a source that needs more attention. Code needs to move away from using Sa(1s) fixed when estimating demands
Applications	PBEE, any prediction modeling involving stochastic IMs

Entropy = -sum(p(z) * log p(z))

Analytical solution available if normal or lognormal distribution (like IMs from GMPE, or error from prediction model)

If not, a nonparametric k-nearest neighbor approximation is available