Probabilistic Approach to Natural Hazards Assessment

Discussion

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- Hazard curve as a system

Epistemic uncertainties in risk assessment

Aleatoric or epistemic? Does it matter?

Kiureghian and Ditlevsen, 2008

Estimation of the position of the typhoon at time step i+1 :

$$\Delta \ln V_i = a_1 + a_2 \ln V_i + a_3 \Phi_i + \varepsilon_V$$

$$\Delta \Phi_i = b_1 + b_2 V_i + b_3 \Phi_i + b_4 \Phi_{i-1} + \varepsilon_\Phi$$

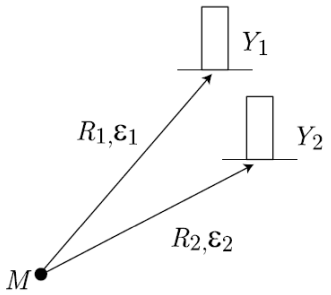
V_i = translation speed $[m/s]$ at time step i

Φ_i = translation angle $[^\circ]$ at time step i

Peak ground motions Y_1 and Y_2 at site 1 and 2 given an earthquake:

$$Y_1 = \varepsilon_1 \bar{Y}(M, R_1)$$

$$Y_2 = \varepsilon_2 \bar{Y}(M, R_2)$$



Epistemic uncertainties in risk assessment

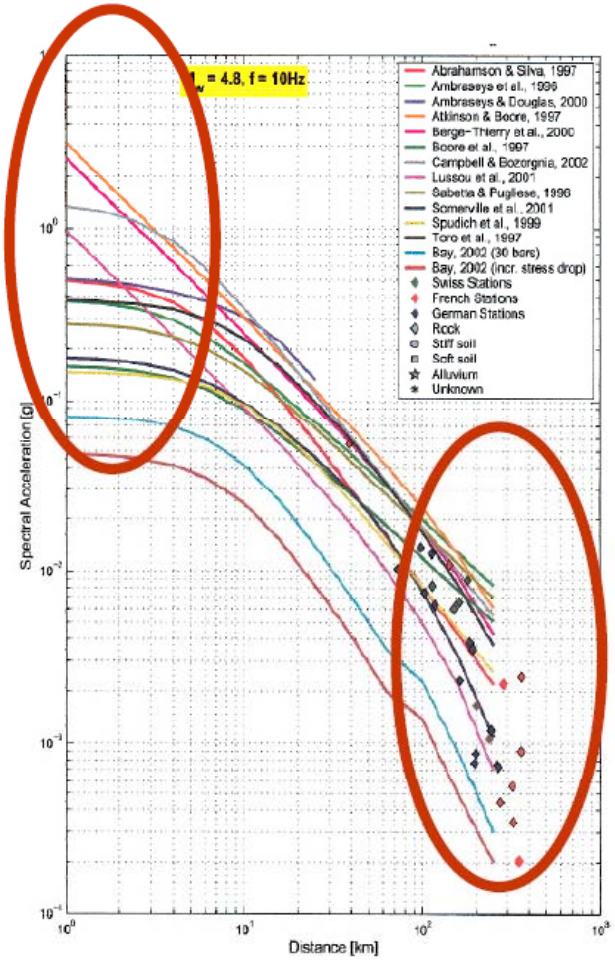
- Repeated uses of model in risk assessment

Temporal: $\varepsilon_1^{(1)}, \varepsilon_1^{(2)}, \varepsilon_1^{(3)}, \ldots$

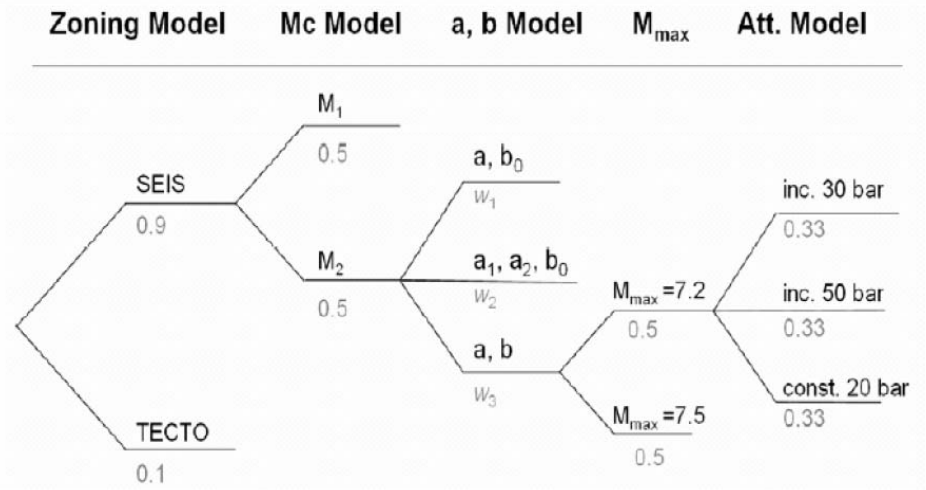
Spatial: $\varepsilon_1, \varepsilon_2, \varepsilon_3, \ldots$

and their mixture.

Hazard curve as a system

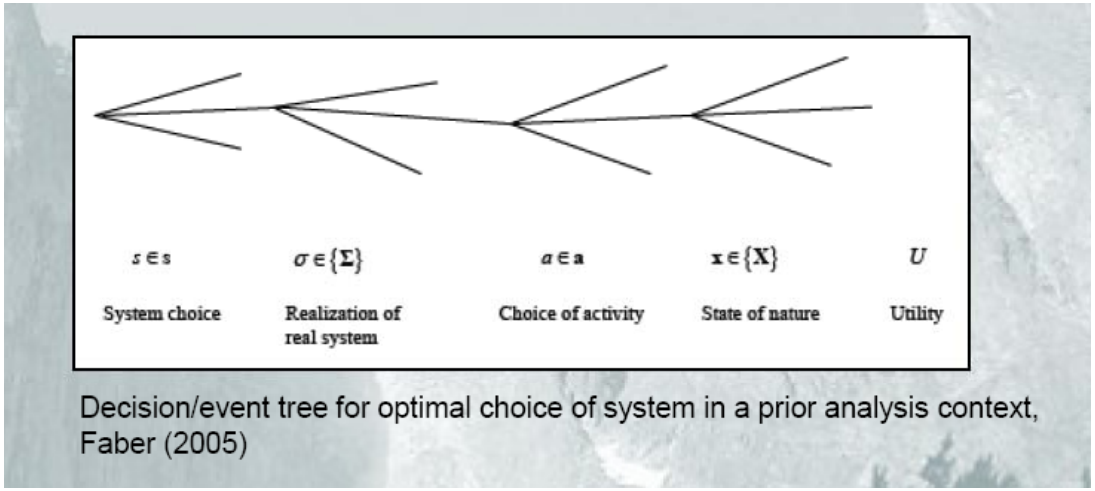


Logic tree : epistemic vs. aleatory

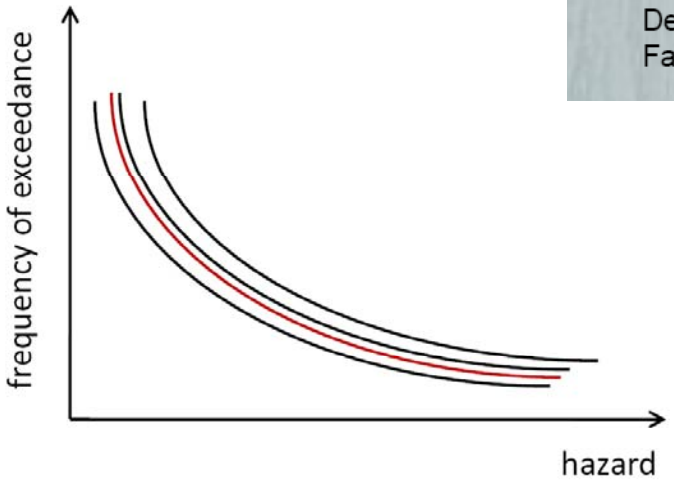


Seismic Hazard Assessment
of Switzerland, 2004

Hazard curve as a system



Decision/event tree for optimal choice of system in a prior analysis context, Faber (2005)



epistemic distribution of hazard curves

Hazard curve as a system

- Simple numerical example

Joint probability (case 1 (left) and case 2 (right))

	NF	F
NF	0.25	0.25
F	0.25	0.25

Independent

	NF	F
NF	0.5	0
F	0	0.5

Dependent

Hazard curve as a system

Independent

	NF	F
NF	0.25	0.25
F	0.25	0.25

Dependent

	NF	F
NF	0.5	0
F	0	0.5

Cost of simultaneous failures: CFF

Cost of one failure: CF.

Expected costs:

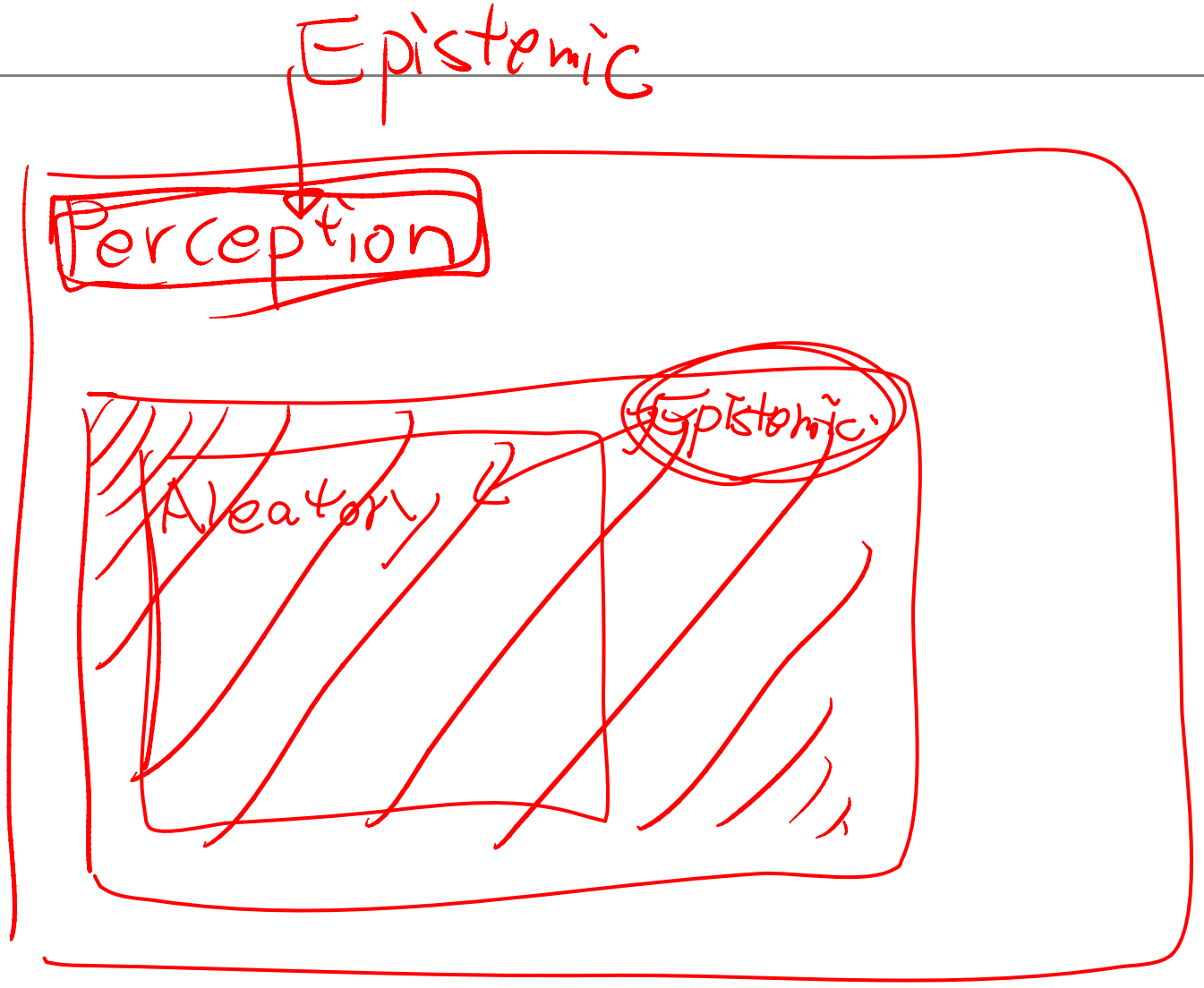
Case 1: 0.5*CF+0.25*CFF

Case 2: 0.5*CFF

0.25 C_F ×2

+C_F × 0

Equals iff CFF=2*CF.


Epistemic
Perception
Aleatori
Epistemic