Bayesian Inference for NMR

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SAMBa ITT6

The Problem

- Nuclear Magnetic Resonance (NMR) on rocks
- Measure relaxation times T_1, T_2
- Want distribution of pore sizes

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Solve integral equation

$$M(\tau_1^{(i)}, \tau_2^{(j)}) = \int_0^{T_{1,B}} \int_0^{T_{2,B}} P(T_2, T_1) \exp\left\{-\frac{\tau_2^{(i)}}{T_2}\right\} \left[1 - \exp\left\{-\frac{\tau_1^{(i)}}{T_1}\right\}\right] dT_2 \, dT_1 + e(\tau_1^{(i)}, \tau_2^{(j)}),$$

M - data, e - Gaussian noise

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1D model

$$M(\tau_1^{(i)}) = \int_0^{T_{2,B}} P(T_2) \exp\left\{-\frac{\tau_2^{(i)}}{T_2}\right\} dT_2 + e(\tau_1^{(i)}),$$

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Tools available

- BayeSys and MassInf
    - Programme to perform Bayesian inference with an atomic prior
    - Simulates from posterior distribution and calculates evidence

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- Data
  - e.g. Carbonates DO_01
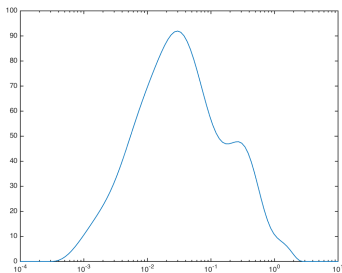
Questions

- How to apply BayeSys/MassInf to our problem?
  - Prior, Likelihood, Data
- Can we calculate moments of posterior distribution?
- Can we compare different models?