



History of MCMC – Gibbs sampler

Big picture: Session 3

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Idea of Gibbs sampling

- MCMC technique to estimate an unknown joint distribution by sampling one variable at a time from its conditional distribution where all other variables are fixed at their current value
- Useful when joint distribution is hard to derive or sample from directly
- Made many previously unsolvable problems solvable



Algorithm

1. Given unknown $f(\theta_1, \dots, \theta_p)$ but known $f(\theta_i | \theta_j)$
2. Start iteration with arbitrary values $\theta_1^0, \dots, \theta_p^0$
3. Sample θ_1^1 from $f(\theta_1 | \theta_2^0, \dots, \theta_p^0)$
4. Sample θ_2^1 from $f(\theta_2 | \theta_1^1, \theta_3^0, \dots, \theta_p^0)$
5. Continue until θ_p^1 sampled from $f(\theta_p | \theta_1^1, \dots, \theta_{p-1}^1)$
6. Start next iteration with values $\theta_1^1, \dots, \theta_p^1$
7. Repeat over n iterations
8. As $n \rightarrow \infty$, $\theta_1^n, \dots, \theta_p^n$ converges to $\sim f(\theta_1, \dots, \theta_p)$



History

- 1902: Josiah Willard Gibbs' work in statistical physics
- 1984: Geman brothers formulated Gibbs sampler in their image restoration work with Gibbs random fields
- 1990: Gelfand and Smith demonstrated broad applicability of Gibbs sampler in (Bayesian) statistics
- 1991: BUGS (MRC Biostatistics Unit, Cambridge)
- 2007: JAGS (Martyn Plummer)



Thank you!



References

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