

# Bayesian data analysis – reading instructions ch 10

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## Chapter 10

Outline of the chapter 10

- 10.1 Numerical integration (overview)
- 10.2 Distributional approximations (overview, more in Chapter 4 and 13)
- 10.3 Direct simulation and rejection sampling (overview)
- 10.4 Importance sampling (used in PSIS-LOO discussed later)
- 10.5 How many simulation draws are needed? (Important! Ex 10.1 and 10.2)
- 10.6 Software (can be skipped)
- 10.7 Debugging (can be skipped)

Sections 10.1-10.4 give overview of different computational methods. Some of them have been already used in the book.

Section 10.5 is very important and related to the exercises.

Demos

- demo10\_1: Rejection sampling
- demo10\_2: Importance sampling

Find all the terms and symbols listed below. When reading the chapter, write down questions related to things unclear for you or things you think might be unclear for others.

- unnormalized density
- target distribution
- log density
- overflow and underflow
- numerical integration
- quadrature
- simulation methods
- Monte Carlo
- stochastic methods
- deterministic methods
- distributional approximations
- crude estimation
- direct simulation
- grid sampling
- rejection sampling
- importance sampling
- importance ratios/weights

## Quadrature

Sometimes ‘quadrature’ is used to refer generically to any numerical integration method (including Monte Carlo), sometimes it is used to refer just to deterministic numerical integration methods.

## Rejection sampling

Rejection sampling is mostly used as a part of fast methods for univariate sampling. For example, sampling from the normal distribution is often made using Ziggurat method, which uses a proposal distribution resembling stairs.

## Importance sampling

Popularity of importance sampling is increasing. It is used, for example, as part of other methods as particle filters and pseudo marginal likelihood approaches, and to improve distributional approximations.

Importance sampling is useful in importance sampling leave-one-out cross-validation. Cross-validation is discussed in Chapter 7 and importance sampling leave-one-out cross-validation is discussed in the article

- Aki Vehtari, Andrew Gelman and Jonah Gabry (2016). Practical Bayesian model evaluation using leave-one-out cross-validation and WAIC. In *Statistics and Computing*, 27(5):1413–1432. arXiv preprint arXiv:1507.04544 <<http://arxiv.org/abs/1507.04544>>

## Buffon’s needles

Computer simulation of Buffon’s needle dropping method for estimating the value of  $\pi$  <http://www.metablake.com/pi.swf>.

## MCMC animations

- Markov Chains: Why Walk When You Can Flow? <http://elevarth.org/blog/2017/11/28/build-a-better-markov-chain/>
- MCMC animation site by Chi Feng <https://chi-feng.github.io/mcmc-demo/>
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