

Assignment 2: Sampling Algorithms

Bayesian Inference and Computation

1 Purpose

As well as developing your understanding of Chapters 3 and 4 of the lecture notes, the coursework is designed to give you an opportunity to

- Translate theoretical properties of statistical methods into code.
- Express your mathematical understanding in code.
- Develop your sense of what good, clear code looks like.

2 Task

1. Use a sampling approach to estimate the volume of the ball in \mathbb{R}^4 with centre at the origin and radius 0.5. Using $M = \{10, 10^2, \dots, 10^6\}$ samples, plot the error in your estimate as the number of samples increases. Consider this error on different scales to propose a formula for the size of the error in terms of the number of samples.
2. Develop an algorithm to sample from the following distribution and use R to generate 5,000 samples from it using your algorithm.

$$f(x) = \begin{cases} 4xe^{-2x^2} & x \geq 0 \\ 0 & x < 0. \end{cases}$$

3 Submission

There are two ways to submit your assignment. The first is to submit the assignment in two parts: a PDF and an R Script. The second is to submit a PDF or HTML file using notebook software that combines \LaTeX and R code (e.g. RMarkdown). Whichever way you choose, the submission must be made through Canvas.

The coursework will be designed to be completed with roughly 2–3 hours of work. You should also make sure you are familiar with the school/university regulations and guidelines on **plagiarism**.

Each part is worth 10 marks for a total of 20 marks. Three marks are available in each part for coding style and presentation.

Marks	Requirements
7	Completes the task in full with no errors
5-6	Completes the tasks in full but contains minor errors
3-4	Makes some progress towards the completing the task but is incomplete or contains serious errors.
0-2	Makes little or no progress towards completing the task.

Table 1: Mark scheme for the task element

Marks	Requirements
3	Code is fully commented, with suitably and consistently named variables. Any plots are fully labelled.
1-2	Code is mostly commented and coding style is mostly consistent, but some parts are either not commented or consistently named
0	Code contains little or no comments and coding style is incoherent.

Table 2: Mark scheme for the coding style and presentation element