

STA 3431 (Monte Carlo Methods), Fall 2020

Project Assignment: worth 25% of final course grade

Due: On Quercus by 1:00 p.m. **sharp** (Toronto time) on Friday November 27.

The project assignment may be summarised as follows: find an interesting and challenging quantity to compute, and conduct a Monte Carlo investigation to compute it.

More specifically, you should begin by finding an interesting and challenging quantity to compute. The quantity could be inspired by a research paper that you read, or an application related to your own field of research, or a topic of general interest to you. You could focus on anything from statistical inference to bioinformatics applications to artificial intelligence to card shuffling to game playing to astronomy – try to be creative. The quantity does not have to be completely original, i.e. it can be related to topics discussed elsewhere, as you long as you cite this in your project. Above all, make sure that the quantity is challenging to compute, i.e. that simple direct computation is infeasible. (Your project should not directly repeat material from another course or project, though it could be related. If you do make any use of results or programs or ideas from other sources or other courses, then this should be clearly explained.)

Then, you should attempt to compute this quantity using various Monte Carlo methods (perhaps those developed in class, perhaps others). Ideally, for each method you should investigate its success or failure, with as much computational evidence as possible, together with whatever theoretical analysis (e.g. standard errors, or geometric ergodicity, or ...) you can manage. (It is okay if some or all of the methods fail.) Finally, you should state your conclusions, regarding the value(s) you were trying to compute, and also regarding which Monte Carlo methods did or did not work well.

The main part of your project should be a **maximum of twelve double-spaced pages**. However, it can also include an **Appendix** of any length, which may or may not be read by the grader. Full source code and program output for all software you write should be included (perhaps in the Appendix, with appropriate summaries in the main part), with programs well commented and easy to follow. Your topic, motivation, methodology, and results, should all be **very clearly explained** within the main part of the project, with supplementary materials and additional explanations in the Appendix.

It is intended that students will complete this assignment individually. However, if you wish, with advance permission, you may work in a group of 2–3 students on a correspondingly larger project; contact the instructor **by November 12** if you are considering this option.

This assignment is rather open-ended, and the amount of investigating that you do is up to you. However, since it is worth 25% of your final course grade, your investigation and write-up should be reasonably substantial, involving significant amounts of discussion, analysis, and computer programming. You may contact the instructor with questions.

ALTERNATIVELY: If you prefer, you can instead investigate a theoretical or methodological issue related to topics in this class. Proposals for such projects should be emailed to the instructor for approval **by November 12**. And, the resulting project should be of equivalent length and difficulty and sophistication as the above usual computational projects.