PHYS 4807/5002 – Fall 2025

Statistical Data Analysis Techniques for Physics

We, the people of the Faculty of Science at Carleton University, acknowledge that our campus is located on the traditional, unceded territories of the Algonquin Anishinabeg people. Miigwetch for your hospitality and stewardship of this territory and the teachings that come from it. We are grateful for this land, the air that we breathe, and the water that sustains us all as well as for the animals, plants and other living beings: these enable us to research, teach, mentor, support, study, and learn. We recognize our responsibility to our natural environment and to reconciliation with Indigenous peoples.

Course Instructor: Prof. Simon Viel

How to address me: by first name

Gender Pronouns: (he/him)

Email: sviel@physics.carleton.ca

N.B. Please include "PHYS4807" or "PHYS5002" in the email subject line.

If you have or question or would like to talk with me, you can send an email, visit me during student hours (see below), or approach me after lecture.

Student Hours: Weekly TBA, and by appointment (send me an email)

N.B. Because of research travel, there will be no class on Wednesday Nov. 12, 2025

There will be a class on Friday Dec. 5, 2025 as Carleton will follow a Monday schedule.

Office Location: HP 3370

Class Location: TBA

Class Times: Mondays and Wednesdays 4:05 – 5:25 pm

Prerequisites: an ability to program in Python, Java, C, or C++, and permission of the Department.

Preclusions: Cross-listed, PHYS 4807 precludes PHYS 5002 and vice versa.

Department/Unit: Physics

Course TAs: TBA

Topics Covered

Official course description: Computational methods used in analysis of experimental data. Introduction to probability and random variables. Monte Carlo methods for simulation of random processes. Statistical methods for parameter estimation and hypothesis tests. Confidence intervals. Multivariate data classification. Unfolding methods. Examples taken primarily from particle and medical physics.

The primary course content is that of the textbook, with supplementary material to be provided in the lectures and course notes on Brightspace.

Topic	Textbook Chapter
Introduction to statistics and probability	1
Probability density functions	2
The Monte Carlo method	3
Hypotheses and test statistics	4
Parameter estimation and maximum likelihood	5, 6
The method of least squares	7
Confidence intervals and limits	9
Unfolding	11
Multivariate classification and regression algorithms, including neural networks	Extra material

Important dates and deadlines can be found here: https://carleton.ca/registrar/registration/dates/academic-dates/, including class suspension for fall, winter breaks, and statutory holidays.

Assessments

COMPONENT	GRADE VALUE
ASSIGNMENTS	50 %
MIDTERM	15 %
FINAL EXAM	35 %

Research about learning strongly suggests that **the most important factor in learning is doing the work** of reading, writing, recalling, practicing, synthesizing, and analyzing. Learning happens best when people actively engage material on a consistent basis, and that is why we have high standards in this course. We are confident that, with appropriate effort, you all can meet those standards.

Requirements for Undergraduate and Graduate Students

This course is offered at the undergraduate and graduate level, with different requirements. Additional questions may be assigned to graduate students on assignments and exams.

Assignments (50%)

Eight sets (number subject to change) of written homework problems will be assigned during the term. They will be due one week after they are assigned.

If you have any questions, please do not hesitate to send me an email or visit me during student hours.

You are encouraged to study together, and write separately. **The work you hand in must be your own**. Replicated / copied / plagiarized assignments (this includes AI-generated answers) will receive a grade of zero.

Grade flexibility: Each student's homework assignment with the lowest percentage grade (except for disciplinary reasons) will not be considered when calculating the contribution of homework assignments to the final grade.

Midterm Exam (15%)

The midterm exam will be during a regular lecture period, immediately before or after Reading Week (instructor to decide after consulting the class). This exam will be will be open book and open notes.

If the final exam percentage grade is higher than the midterm exam grade, then the midterm exam will receive a percentage grade equal to that of the final exam. The final exam is expected to be harder than the midterm exam, so do not rely on this!

Final Exam (35%)

There will be a 3-hour written final exam, during the final examination period in December. The final exam will be open book and open notes. **The final exam is a requirement** to successfully complete this course.

Late and Missed Work Policies

Late Work
Late work will not necessarily be accepted and may result in a grade of zero. It is your responsibility to **email the instructor** ahead of the deadline to request an extension. It is also possible to use the academic considerations form.

Missed Work

Short-term (5 days or less): For assignments, please see the above statement on late work. There will be no deferred midterm exam; if the midterm exam is missed, then the midterm exam will receive a percentage grade equal to that of the final exam.

Long-term (> 5 days): Please email the instructor, or use the longer-term accommodation request form.

Learning Materials

Learning Material	Options for Purchasing	Approximate Cost
Textbook: Statistical Data Analysis by Glen Cowan	University Bookstore, Online, etc.	$87.00 (new, paperback)

While students often find that reading the textbook is an essential part of learning the course material, **students are not required to purchase textbooks or other learning materials for this course**.

Course notes will be posted on Brightspace. The course notes are protected by **copyright**: they are for your own educational use, but you are *not* permitted to share them.

Academic Accommodations and Regulations

Carleton is committed to providing academic accessibility for all individuals. You may need special arrangements to meet your academic obligations during the term. The accommodation request processes are outlined on the Academic Accommodations website (https://students.carleton.ca/course-outline/).

University rules regarding registration, withdrawal, appealing marks, and most anything else you might need to know can be found on the university's website, here:
https://calendar.carleton.ca/undergrad/regulations/academicregulationsoftheuniversity/

Statement on Artificial Intelligence Usage

The use of large-language models and generative AI for course work is prohibited.

As our understanding of the uses of AI and its relationship to student work and academic integrity continue to evolve, students are required to discuss their use of AI in any circumstance not described here with the course instructor to ensure it supports the learning goals for the course.

Statement on Academic Integrity

Students are expected to uphold the values of academic integrity, which include fairness, honesty, trust, and responsibility. Examples of actions that that compromise these values include but are not limited to plagiarism, accessing unauthorized sites for assignments or tests, unauthorized collaboration on assignments or exams, and using AI tools such as ChatGPT when your assessment instructions say it is not permitted.

Misconduct in scholarly activity will not be tolerated and will result in consequences as outlined in Carleton University's Academic Integrity Policy. A list of standard sanctions in the Faculty of Science can be found here.

Additional details about this process can be found on the Faculty of Science Academic Integrity website. Students are expected to familiarize themselves with and abide by Carleton University's Academic Integrity Policy.

Student Rights & Responsibilities

Students are expected to act responsibly and engage respectfully with other students and members of the Carleton and the broader community. See the 7 Rights and Responsibilities Policy for details regarding the expectations of non-academic behaviour of students. Those who participate with another student in the commission of an infraction of this Policy will also be held liable for their actions.

Student Concerns

If a concern arises regarding this course, **your first point of contact is me**: Email or drop in during student hours and I will do my best to address your concern. If I am unable to address your concern, the next points of contact are (in this order):

Note: You can also bring your concerns to Ombuds services.