ECE 203: Probability and Statistics I
Fall 2021

Instructor: Prof. Patrick Mitran

- Office Hours: Mondays, 4:30pm-5:30pm, by Zoom
- E-mail: pmitran@uwaterloo.ca
- Prof. Mitran's Zoom link:
  https://uwaterloo.zoom.us/j/6670874658?pwd=QVg4MGkva2t3OFlmMWRBZnJvYUxpZz09
- Exception: On 27 September, the office hours will be from 10am-11am instead.

As the intention is that Prof. Mitrans's tutorials will be recorded, office hours will NOT be recorded for later viewing. If no one joins the session after 10min, I may cancel the rest of the session.

Due to current circumstances, responding to email may be delayed. Please include "ECE203" in the subject line of any email.

Tutorial Schedule: Fall 2021 will be a hybrid term with a mix of online and in-person contact. The lecture content will be delivered through pre-recorded videos. The schedule of which videos to watch in which week is in this syllabus below.

Pre-recorded lectures will be posted on Learn, with one week's worth of videos *posted ahead of time* so that you can choose to work ahead by 1 week. The videos range from about 10min to 30min with the average about 20min in length.

The in-person content will be delivered by myself, and the TA. Specifically, I will deliver 1 hour of problem solving each week in the morning, and the TA will provide a 1 hour tutorial each week in the morning. As the morning section is sub-divided into 3 sub-sections, the TA and I intend to stagger our in-person time so that each sub-section receives the same number of contact hours from each of us over the term. The intention is that Prof. Mitran's in-person lectures will be recorded with links posted on Learn so that students who could not attend can watch the recodings.

The TA and I will also do the same for the afternoon section.

I suspect that the tutorial content I want to cover in some weeks may be longer than can fit in a 1 hour tutorial. In such cases, I will continue in the afternoon section with the problems not covered in the morning section.

Links for tutorials run by:

- Prof. Mitran:
  https://uwaterloo.zoom.us/j/6670874658?pwd=QVg4MGkva2t3OFlmMWRBZnJvYUxpZz09

The tutorial schedule is available on the Learn webpage, and is subject to change. Also see "alternate arrangements" below. Also, if there is insufficient attendence in-person/online, some or all tutorials may be moved online or canceled.

Tutorials Recording:

Some or all of the course tutorials may be recorded. As such, it is possible that your appearance, image, text/chat messaging, voice and/or likeness may be recorded.

If you are joining the tutorials remotely, please disable your camera. Disabling your microphone and camera can minimize your appearance, image, text/chat messaging, voice and/or likeness in the recordings. Nevertheless, your name/pseudonym and other information may appear in the recording. If you join the tutorials in-person, it is possible your appearance, image, text/chat messaging, voice and/or likeness may be recorded.

The full STUDENT NOTICE OF RECORDING is at the end of the syllabus.

Tutorials: Samira Ghanbarian; Format: In-person 1 hour/week in each of morning and afternoon.

Discussion: Piazza will be used for course discussion.
Self-signup: piazza.com/uwaterloo.ca/fall2021/ece203
Access-code: Poisson203
Mahmoud Abouamer will respond to most piazza discussions.

Test/Exam Submission: We will be using crowdmark for test and exam submission. Information on how to use crowdmark can be found at the link below.

https://crowdmark.com/help/completing-and-submitting-an-assessment/

If you experience difficulties in submitting your tests or exam, you can email me your solutions.

There will also be a practice test, Test#0, that counts for 0% in week 2. This is so that you may get acquainted with crowdmark. Test#0 should not take more than 10 min to "solve", but you will have 8 hours.

Teaching Assistants:

- Samira Ghanbarian (s4ghanba@uwaterloo.ca)
- Mahmoud Abouamer (mabouame@uwaterloo.ca)
- Fatemeh Fardno (ffardno@uwaterloo.ca)
- Seyyed Mojtaba Pourjaafari (smpourja@uwaterloo.ca)

Due to COVID-19, the method of lecture and tutorial delivery is subject to change. I may need to revise our methods as we go.

Pre-requisite: Discrete math and calculus.

Aims: This is the first in a sequence of two courses. This course concentrates mostly on probability theory. The second course will concentrate mostly on statistics.

Course Outline

1. Introduction to probability: Axioms, sample spaces, events, and set operations. Sample spaces with equally likely outcomes
2. Independence and conditioning: Independence, conditional probabilities, law of total probability, Bayes' formula
3. Random variables and distributions: Expectation, moments, common distributions
4. Continuous Random Variables
5. Joint distributions and jointly distributed random variables: Joint distributions, sums of independent random variables, conditional distributions
6. Expectations and their properties: Moments, moment generating functions, characteristic functions, conditional expectation and its properties, jointly Gaussian (Normal) random variables
7. Limit theorems: Probability inequalities, Central Limit Theorem (CLT), Weak Law of Large Numbers

Textbook and references

Course text: There is a required course text. It is a well written book and well worth investing in. Homework problems are assigned from the textbook. I strongly recommend obtaining a copy of the textbook, either a hard copy, or soft copy.

A First Course in Probability, (10th edition), Sheldon Ross, Pearson/Prentice-Hall, 2019.

There are many other good books that deal with the material. Two books that I think are well written and also cover the material are below. I myself learned from the 2nd edition of the Leon-Garcia book when I took a similar course.

Introduction to probability, D. P. Bertsekas and J. N. Tsitsiklis, Athena Scientific , 2002. ISBN 1-886529-40-X.

Probability and Random Processes for Electrical Engineering , Albert Leon-Garcia, Pearson, 2007, ISBN 978-0131471221

Another book that is often used is

Probability, Random Variables and Stochastic Processes (4th Edition), A. Papoulis, S. U. Pillai, McGraw-Hill

Course Evaluation

- Homework problem sets will be handed out. You should attempt them all. They are not graded. Do not hand them in. Solutions will be posted on the course website. *Please do not ask me to provide the text of the assigned textbook problems: I cannot.*

- There will be a class Test#0 in week 2. This test will count for 0% of your grade.

  The purpose of the test is to get everyone to try crowdmark, and verify that we can read your solutions. The questions on Test#0 will either i) be for our information, ii) test that you can use crowdmark, or iii) verify that we can read your writing.

  We will not evaluate the correctness of your answers, but the legibility. The test should take no more than 10 min to "solve" plus the time to upload.

- There will be 2 class tests scheduled for weeks 5, 9. These will each count for 25% of the grade.

  These will be timed 1.5 hour tests with an additional 0.5 hours to deal with technology considerations. There will be a 24 hour window during which you must start, complete and submit the test, with 2 hours to complete and submit from when you start. So if you want the full 2 hours, you need to start the test no later than 22 hours into the 24 hour window.

  We will use crowdmark for test submission. I understand that the additional 30 minutes may be needed partly at the start of the test, to upload answers midway through the test, etc. Also, there is no way for me to track how you use your time. So the 2 hours total time can be used any way you want, but I recommend you submit your test with plenty of time to spare. You can always re-submit newer solutions up until the deadline.

  Weeks that have tests will have reduced video lectures.

- There will be a final exam that will count for 50% of the grade. The duration of the final is 2.5 hours plus 0.5 hours to deal with technology considerations, so 3 hours total. There will be a 24 hour window during which you must start, complete and submit the exam, with 3 hours to complete and submit from when you start. We will use crowdmark for final exam submission.

I reserve the right to provide an alternative grading scheme as necessary if the class grades are below what I deem reasonable. I guarantee that no student shall receive a grade less than that of the official scheme above, but the alternate scheme, if any, may improve your grade.

If, due to academic dishonesty, a penalty is applied to your grade in the official scheme, the same penalty will be applied to the alternate scheme, if any. For example, suppose a student receives a grade of 80% on test#1, but, as a result of academic dishonesty, has this grade reduced to 0%. Then, a penalty of $-80\% \times 25\% = -20\%$ *was effectively applied to the course grade. Hence, if a 100% final option is offered as an alternate grading scheme, then this penalty of -20% will be applied to the alternate scheme even though in the alternate scheme test#1 has no weight.*

- Test#0
  Weight: 0%

Time allowed: 8 hours (so you can experiment as you want)
Window: 10:00am/16 Sept to 10:00am/17 Sept

- Test#1
  Weight: 25%
  Time allowed: 1.5+0.5 = 2.0 hours
  Window: 10:00am/7 Oct to 10:00am/8 Oct

- Test#2
  Weight: 25%
  Time allowed: 1.5+0.5 = 2.0 hours
  Window: 10:00am/11 Nov to 10:00am/12 Nov

- Final Exam
  Weight: 50%
  Time allowed: 2.5+0.5 = 3.0 hours
  Window: 24 hour window to be determined by the university

Allowed aids: You are allowed access to *only* the following resources during the tests and final: i) any personal notes you take, as long as you composed them yourself prior to the test (this includes notes based on the lectures/videos, tutorials, office hours, textbook, or other book), ii) any content available on the ECE203 Learn website (including all videos) and ECE203 Piazza website, iii) the course textbook, iv) a non-graphing, non-programmable calculator. Access to Matlab or similar computational software is prohibited.

During the test/final period, you may not use the internet other than i) to access the course ECE203 webpage on Learn and ECE203 Piazza discussions, ii) to access the textbook (if ecopy), iii) to access crowdmark, or iv) send email to me or receive email from me. You may not communicate directly or indirectly with your classmates or anyone else except for me. You may use a computer, tablet or phone for only the following purposes: i) to create/scan/upload your solutions, ii) to access crowdmark, iii) to access Learn and Piazza, iv) to access your personal notes (if you took these electronically), v) to access the textbook, vi) to send/receive email to/from me, or vii) to be used as a basic calculator following the calculator rule above.

Use of any file sharing services such as chegg.com is prohibited.

During the test/final period, do not post any questions on Piazza. If you have a question, please email me.

The time window for the tests/final may be increased at the discretion of the instructor.

Due to COVID-19, dates, times and durations are subject to change. Also, alternate grading schemes, exam arrangements, or course deliverables may be necessary. These will be communicated when available. The instructor also reserves the right to use alternative grading schemes in special circumstances. For example, if an accommodation is necessary, an alternative grading scheme may be used for individual students.

Alternate Arrangements: The situation may change/evolve due to several reasons. For example,

the instructor becomes unavailable (e.g., the instructor is sick, etc.), the tutorial TA is unavailable, Public Health orders in-person lectures be stopped, etc. This change may be short-term (e.g., one week) or long-term.

Should the situation change and in-person tutorials are no longer possible for either a short-term period or long-term period, depending on the reason for this, the instructor led tutorials will either be, i) moved to a different tutorial section if feasible, ii) moved online as live online tutorials, or iii) canceled. The in-person tutorials from the TA will be cancelled.

Due to privacy reasons, I may not always be able to provide a reason for these changes to in-person tutorials.

The streaming and recording of in-person tutorials is contingent on video streaming equipment. Two weeks before the start of classes, I was informed that STC-0050 and STC-0060 are not going to be equipped with video streaming equipment. Nevertheless, I believe I may be able to live stream from STC with my own equipment. The E7 classroom should be equiped with functional streaming equipment before the first streamed tutorial in that room is scheduled to occur. Neverteless, the equipment may not be up and running, or may malfunction, etc. In the event that streaming/recording from a room is difficult or impossible, I may move my streamed/recorded tutorials to days in which the assigned rooms have easier/feasible streaming/recording. Depending on the streaming capability/feasibility of STC and E7 rooms, it is also possible that the assigned rooms of the tutorials may be changed. Alternatively, if I am not able to stream/record from either STC or E7 rooms, my tutorials may be moved entirely online.

Also, if there is insufficient attendence in-person/online, some or all tutorials may be moved online or canceled.

Self-Isolation: Students who are required to self-isolate can follow the course online similar to a student who chooses to attend the course online.

Course Schedule: The tentative schedule for the semester is as follows. *This may be revised based on circumstances at the instructor's discretion.* In such a case, the revisions will be communicated to the class on the Learn webpage.

- Anytime:

  Reading: Sections 1.1 – 1.4, ECE108 "book" (available on Learn) as needed.
  Homework: Can do all of HW#0

- Week 1: 8 Sept – 10 Sept

  Reading: Sections 2.1 – 2.5
  Videos: 01_intro [optional video]
  . 02_axioms_of_prob1
  . 03_axioms_of_prob2
  . 04_axioms_of_prob3 Can do all of HW#1
  Tutorials: Prof. Mitran (Friday; course introduction)

- Week 2: 13 Sept – 17 Sept

  Reading: Sections 3.1 – 3.5
  Videos: 05_cond_prob1
  . 06_cond_prob2
  . 07_cond_prob3 Can do all of HW#2
  Office Hour: 13 Sept from 4:30pm to 5:30pm on zoom
  Tutorials: Covers videos 02 to 04

  Tests: We will do a dry run (Test#0) of crowdmark on 16 Sept to verify that everyone can access crowdmark.

- Week 3: 20 Sept – 24 Sept

  Reading: Sections 4.1 – 4.5
  Videos: 08_rand_vars1
  . 09_rand_vars2
  . 10_rand_vars3
  . 11_rand_vars4 Can do up to 27 and 31-39 of HW#3
  Office Hour: 20 Sept from 4:30pm to 5:30pm on zoom
  Tutorials: Covers videos 05 to 07

- Week 4: 27 Sep – 1 Oct

  Reading: Sections 4.6 (except 4.6.2), 4.7 (except 4.7.1), 4.8.1, 4.9, 4.10
  Videos: 12_rand_vars5
  . 13_rand_vars6
  . 14_rand_vars7 Can do all of HW#3
  Office Hour: 27 Sept from 10:00pm to 11:00am on zoom
  Tutorials: Covers videos 08 to 11

- Week 5: 4 Oct – 8 Oct

  Reading: Sections 5.1, 5.2
  Videos: 15_cont_rand_vars1
  . 16_cont_rand_vars2
  Office Hour: 4 Oct from 4:30pm to 5:30pm on zoom
  Tutorials: Covers videos 12 to 14
  Tests: Test#1 on 7 Oct, covers videos 02 to 14

- Reading Week: 11 Oct - 15 Oct

- Week 6: 18 Oct - 22 Oct

  Reading: Sections 5.3, 5.4 (except 5.4.1), 5.5 (except 5.5.1), 5.7
  Videos: 17_cont_rand_vars3
  . 18_cont_rand_vars4
  . 19_cont_rand_vars5
  . 20_cont_rand_vars6 Can do all of HW#4
  Office Hour: 18 Oct from 4:30pm to 5:30pm on zoom

Tutorials: Covers videos 15 to 16

- Week 7: 25 Oct - 29 Oct

  Reading: Sections 6.1, 6.2
  Videos: 21_cont_rand_vars7 [optional video]
  . 22_joint_dist_rv1
  . 23_joint_dist_rv2
  . 24_joint_dist_rv3 Can do up to 23 of HW#5, and TE1, TE2, TE6, TE18.
  Office Hour: 25 Oct from 4:30pm to 5:30pm on zoom
  Tutorials: Covers videos 17 to 20

- Week 8: 1 Nov - 5 Nov

  Reading: Sections 6.2, 6.3 (except 6.3.2), 6.4, 6.5
  Videos: 25_joint_dist_rv4
  . 26_joint_dist_rv5
  . 27_joint_dist_rv6
  . 28_joint_dist_rv7 Can do up to 52 and up to TE20 of HW#5
  Office Hour: 1 Nov from 4:30pm to 5:30pm on zoom
  Tutorials: Covers videos 21 to 24

- Week 9: 8 Nov - 12 Nov

  Reading: Sections 6.7, 7.1, 7.2 (except 7.2.1, 7.2.2)
  Videos: 29_joint_dist_rv8 Can do all of HW#5
  . 30_prop_expt1
  Office Hour: 8 Nov from 4:30pm to 5:30pm on zoom
  Tutorials: Covers videos 25 to 28

  Tests: Test#2 on 11 Nov, covers Videos 15 to 20 and 22 to 28

- Week 10: 15 Nov - 19 Nov

  Reading: Sections 7.2 (except 7.2.1, 7.2.2), 7.4, 7.5 up to 7.5.2
  Videos: 31_prop_expt2
  . 32_prop_expt3
  . 33_prop_expt4 Can do up to 73 of HW#6.
  Office Hour: 15 Nov from 4:30pm to 5:30pm on zoom
  Tutorials: Covers videos 29 to 30

- Week 11: 22 Nov - 26 Nov

  Reading: Sections 7.5.2, 7.5.3, 7.5.4, 7.6, 7.7 (except 7.7.1)
  Videos: 34_prop_expt5
  . 35_prop_expt6
  . 36_prop_expt7 Can do up to 80 and up to TE30 of HW#6
  Office Hour: 22 Nov from 4:30pm to 5:30pm on zoom

Tutorials: Covers videos 31 to 33

- Week 12: 29 Nov - 3 Dec

  Reading: Sections 7.7 (including 7.7.1), 7.8 (except 7.8.2), 8.1, 8.2, 8.3
  Videos: 37_prop_expt8 Can do all of HW#6
  . 38_limit_thms1
  . 39_limit_thms1 Can do all of HW#7
  . [Strong Law of Large Numbers is optional]
  Office Hour: 29 Nov from 4:30pm to 5:30pm on zoom
  Tutorials: Covers videos 34 to 36

- Week 13: 6 Dec - 7 Dec

  Tutorials: Covers videos 37 to 39

  Office Hour: 6 Dec Office from 4:30pm to 5:30pm on zoom

- Final exam:

  The final exam will be scheduled by the university for a 24 hour window. During this period, you will have 2.5 hours plus 30 minutes to deal with technology considerations, following the same procedure and rules as the tests.

In-person classroom safety: If you are uncomfortable attending in-person tutorials in any way, please do not attend in-person tutorials. Prof. Mitran's tutorials will be recorded and made available for viewing online.

We will follow all university guidelines. In addition, if I feel there is a safety issue, I reserve the right to cancel the lecture immediately, and ask everyone to leave. If a lecture is cancelled because someone makes the lecture room unsafe, the issue may be raised with the associate dean of undergraduate studies under Policy 71.

A safety presentation is available on the Learn website. Please review the presentation.

- Do not attend a tutorial section that you are not registered in.
- Students shall not attend class if they are experiencing influenza-like illness, have been in close contact with someone who is ill, or have travelled outside of Canada within the past 14 days.
- Wearing of face-covering/mask is a requirement in all common areas on campus, including all indoor instructional spaces.
- As such, no food is allowed to be consumed in instructional space. Beverages are allowed if a straw is used or if the mask is lowered only for a brief period.

- When a student asks or answers a question it may be difficult to be heard while wearing a mask. A student may briefly lower their mask to ask/answer the question and then the mask must be replaced.
- Students are expected to practice frequent hand hygiene (handwashing with soap and water or use of hand sanitizer), including immediately before coming into an instructional space
- Students are permitted to sit where they wish. You are encouraged to sit with one seat left empty between you and other students when possible. Also, please be considerate – the person next to you may want some distance as well.
- If you becomes ill in class: i) please proceed directly home to self-isolate and to contact Health Services' Testing and Assessment Centre to book an appointment for testing, ii) you will be directed on self-isolate and are asked to report a positive test to Health Services via the COVID-19 Support and Advice form:

  https://uwaterloo.ca/campus-wellness/covid-19-testing-assessment-centre/covid-19-support-and-advice
- If you have tested positive for COVID-19: i) report the positive result to Health Services via the COVID-19 Support and Advice form below, ii) staff managing the form submissions will guide you through next steps and co-ordinate tracking the case and initiating Public Health contact tracing.

  https://uwaterloo.ca/campus-wellness/covid-19-testing-assessment-centre/covid-19-support-and-advice
- COVID-19 Return to Campus safety information and protocols:

  https://uwaterloo.ca/coronavirus/return

Academic Integrity: In order to maintain a culture of academic integrity, members of the University of Waterloo community are expected to promote honesty, trust, fairness, respect and responsibility. [Check www.uwaterloo.ca/academicintegrity/ for more information.]

Grievance: A student who believes that a decision affecting some aspect of his/her university life has been unfair or unreasonable may have grounds for initiating a grievance. Read Policy 70, Student Petitions and Grievances, Section 4, www.adm.uwaterloo.ca/infosec/Policies/policy70.htm. When in doubt please be certain to contact the department's administrative assistant who will provide further assistance.

Discipline: A student is expected to know what constitutes academic integrity [check www.uwaterloo.ca/academicintegrity/] to avoid committing an academic offence, and to take responsibility for his/her actions. A student who is unsure whether an action constitutes an offence, or who needs help in learning how to avoid offences (e.g., plagiarism, cheating) or about "rules" for group work/collaboration should seek guidance from the course instructor, academic advisor, or the undergraduate Associate Dean. For information on categories of offences and types of penalties, students should refer to Policy 71, Student Discipline, www.adm.uwaterloo.ca/infosec/Policies/policy71.htm. For typical penalties check Guidelines for the Assessment of Penalties, www.adm.uwaterloo.ca/infosec/guidelines/penaltyguidelines.htm.

Given current circumstances, my default approach to handle any such issues is to refer the matter to the associate dean of undergraduate studies.

Appeals: A decision made or penalty imposed under Policy 70 (Student Petitions and Grievances) (other than a petition) or Policy 71 (Student Discipline) may be appealed if there is a ground. A student who believes he/she has a ground for an appeal should refer to Policy 72 (Student Appeals) www.adm.uwaterloo.ca/infosec/Policies/policy72.htm.

Note for Students with Disabilities: AccessAbility Services, located in Needles Hall, Room 1401, collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with AccessAbility Services at the beginning of each academic term.

Remote Teaching and Learning: STUDENT NOTICE OF RECORDING:

Activities for this course involve recording, in partial fulfillment of the course learning outcomes. You will receive notification of recording via the course syllabus. Some technologies may also provide a recording indicator. Images, audio, text/chat messaging that have been recorded may be used and/or made available by the University to ECE 203 students, TAs and course instructors for the purpose of viewing the ECE203 tutorials. Recordings will be managed according to the University records classification scheme, WatClass, and will be securely destroyed when no longer needed by the University. Your personal information is protected in accordance with the Freedom of Information and Protection of Privacy Act, as well as University policies and guidelines and may be subject to disclosure where required by law.

The University will use reasonable means to protect the security and confidentiality of the recorded information, but cannot provide a guarantee of such due to factors beyond the University's control, such as recordings being forwarded, copied, intercepted, circulated, disclosed, or stored without the University's knowledge or permission or the introduction of malware into computer system which could potentially damage or disrupt the computer, networks, and security settings. The University is not responsible for connectivity/technical difficulties or loss of data associated with your hardware, software or Internet connection.

By engaging in course activities that involve recording, you are consenting to the use of your appearance, image, text/chat messaging, and voice and/or likeness in the manner and under the conditions specified herein. (In the case of a live stream event, if you choose not to have your image or audio recorded, you may disable the audio and video functionality. Instructions to participate using a pseudonym instead of your real name are included where the feature exists; however, you must disclose the pseudonym to your instructor in advance in order to facilitate class participation.) If you choose not to be recorded, this notice serves as confirmation of your understanding that you will only be able to watch the tutorials at a later date after they are recorded.

You are not permitted to disclose the link to/URL of an event or an event session recording or copies of recording to anyone, for any reason. Recordings are available only to authorized individuals who have been directly provided the above instructions/link for their use. Recordings for personal use, required to facilitate your learning and preparation of personal course/lecture notes, should not be shared with others without the permission of the instructor or event coordinator.

Review the University's guidelines for faculty, staff and students entering relationships with external organizations offering access to course materials for more information on your obligations with respect to keeping copies of course materials. For more information about accessibility, connect with AccessAbility Services.