Probability Fall 2024

STAT 230

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Class Schedule

Course	Meet Days	Meet Time	Location	Instructor(s)
STAT 230 001 [LEC]	**Mon, Wed, Fri** *Sep 4 - Dec 3*	11:30AM - 12:20PM	DC 1350	J. Adcock *jradcock@uwaterl...*
STAT 230 002 [LEC]	**Mon, Wed, Fri** *Sep 4 - Dec 3*	09:30AM - 10:20AM	STC 0010	B. Lashkari *blashkari@uwater...*
STAT 230 003 [LEC]	**Mon, Wed, Fri** *Sep 4 - Dec 3*	01:30PM - 02:20PM	MC 1085	P. Shuldiner *pavel.shuldiner@...*
STAT 230 004 [LEC]	**Mon, Wed, Fri** *Sep 4 - Dec 3*	03:30PM - 04:20PM	B1 271	S. Drekic *sdrekic@uwaterlo...*
STAT 230 005 [LEC]	**Mon, Wed, Fri** *Sep 4 - Dec 3*	12:30PM - 01:20PM	RCH 302	G. Rice *grice@uwaterloo....*
STAT 230 101 [TUT]	**Fridays** *Sep 4 - Dec 3*	02:30PM - 03:20PM	EXP 1689	J. Adcock *jradcock@uwaterl...*
STAT 230 102 [TUT]	**Fridays** *Sep 4 - Dec 3*	11:30AM - 12:20PM	STC 0050	B. Lashkari *blashkari@uwater...*
STAT 230 103 [TUT]	**Fridays** *Sep 4 - Dec 3*	08:30AM - 09:20AM	STC 0010	P. Shuldiner *pavel.shuldiner@...*
STAT 230 104 [TUT]	**Fridays** *Sep 4 - Dec 3*	01:30PM - 02:20PM	DC 1350	S. Drekic *sdrekic@uwaterlo...*
STAT 230 105 [TUT]	**Fridays** *Sep 4 - Dec 3*	09:30AM - 10:20AM	EIT 1015	G. Rice *grice@uwaterloo....*

schedule data automatically refreshed daily

Instructor & TA (Teaching Assistant) Information

Instructors:

James Adcock, E-mail: jradcock@uwaterloo.ca (mailto:jradcock@uwaterloo.ca) , Office: M3 3019

Banafsheh Lashkari, E-mail: blashkari@uwaterloo.ca (mailto:blashkari@uwaterloo.ca) , Office: M3 3108

Pavel Shuldiner, E-mail: pavel.shuldiner@uwaterloo.ca (mailto:pavel.shuldiner@uwaterloo.ca) , Office: M3 4108

Steve Drekic, E-mail: sdrekic@uwaterloo.ca (mailto:sdrekic@uwaterloo.ca) , Office: M3 3117

Greg Rice, E-mail: grice@uwaterloo.ca (mailto:grice@uwaterloo.ca) , Office: M3 4117

Instructional Support Coordinator (ISC):

Funmilayo Adeku (she/her), E-mail: fadeku@uwaterloo.ca (mailto:fadeku@uwaterloo.ca) , Office: M3 2128

Contact directly for: remark requests, accommodations (including illness), issues with LEARN, Crowdmark, and Piazza.

Weekly Office Hours:

Instructor office hours will be announced in class and posted on the course website on LEARN (https://learn.uwaterloo.ca/d2l/home) .

Please also note that *Piazza* will be used for answering questions throughout the term. The discussion board will be monitored, but students are also encouraged to answer questions posted, giving their perspective. To join the *Piazza* forum for this course, go here (https://piazza.com/uwaterloo.ca/fall2024/stat230) .

If you need to communicate with your instructor directly for other/personal reasons, please send an e-mail instead.

Course Description

> *Calendar Description for STAT 230:*
>
> This course provides an introduction to probability models including sample spaces, mutually exclusive and independent events, conditional probability and Bayes' Theorem. The named distributions (Discrete Uniform, Hypergeometric, Binomial, Negative Binomial, Geometric, Poisson, Continuous Uniform, Exponential, Normal (Gaussian), and Multinomial) are used to model real phenomena. Discrete and continuous univariate random variables and their distributions are discussed. Joint probability functions, marginal probability functions, and conditional probability functions of two or more discrete random variables and functions of random variables are also discussed. Students learn how to calculate and interpret means, variances and covariances particularly for the named distributions. The Central Limit Theorem is used to approximate probabilities.
>
> View requirements for STAT 230 (https://acal.fast.uwaterloo.ca/course/1249/STAT/230)

Post-requisite:

STAT 231 relies very heavily on the concepts from STAT 230. It is recommended that you take STAT 231 as soon as possible after completing STAT 230. To move forward to STAT 231, you only need a passing grade (50%) in STAT 230. However, to take upper-year STAT courses such as 330, 333, 334, or 340, you need a minimum grade of 60% in STAT 230.

Learning Outcomes

Upon successful completion of this course, you will be able to:

Define a probability model and determine probabilities of events using counting techniques.
Distinguish between mutually exclusive and independent events, and calculate conditional probabilities using Bayes' Rule.
Distinguish between discrete and continuous random variables.
Define and use probability mass functions/probability density functions and cumulative distribution functions to determine probabilities of events.
Use moment generating functions as a tool to determine expected values.
Define and use joint probability mass functions, marginal probability mass functions, and conditional probability mass functions to determine probabilities of events involving two or more discrete random variables.
Use the law of total expectation to calculate expected values through the principle of conditioning.
Use the named distributions (Discrete Uniform, Binomial, Hypergeometric, Geometric, Negative Binomial, Poisson, Continuous Uniform, Exponential, Normal, and Multinomial) to model real-life phenomena.
Calculate and interpret means, variances, and covariances, particularly for the named distributions.
Understand the theory behind several important inequalities in probability and what the Weak Law of Large Numbers conveys.
Define the Central Limit Theorem and use it to approximate probabilities.

Tentative Course Schedule

The following table provides a **tentative** schedule for the material you are responsible for in STAT 230, along with sections in the *Course Notes* indicated. The material in this course is cumulative and you are expected to attend all the lectures, read all the posted lecture notes, and do the end-of-section problems in order to learn the material and prepare for the quizzes, term tests, and final exam. This learning consists of you taking the time to carefully read the lecture notes on your own, making sure you understand the concepts and steps demonstrated in the lectures to tackle examples, and then solving the end-of-section problems. Solutions to the end-of-section problems will be posted in a timely fashion on the course website on LEARN (https://learn.uwaterloo.ca/d2l/home) . However, it is expected that you attempt the problems on your own first prior to consulting the provided solutions. The weeks for tutorials, tutorial quizzes, and term tests are also provided. Please be sure to take note of the important dates indicated below.

Week	Key Topics	Sections	Notes
Week 1 **(Sept. 4 - 6)**	Course Outline Register for Piazza Definitions of Probability, Sample Space, Simple and Compound Events	1.1, 1.2	No tutorial to take place on Friday, Sept. 6
Week 2 **(Sept. 9 - 13)**	Probability/Odds of an Event, Addition and Multiplication Rules for Counting, Permutations and Combinations	1.2, 1.3	Open tutorial: Introductory Material Friday, Sept. 13
Week 3 **(Sept. 16 - 20)**	Review of Set Theory, De Morgan's Laws, Addition Rules for Unions of Events, Mutually Exclusive Events, Independent Events	2.1, 2.2, 2.3	**Quiz 1** to take place during tutorial period on Friday, Sept. 20 (to cover material to the end of Chapter 1)
Week 4 **(Sept. 23 - 27)**	Conditional Probability, Product Rules for Intersections of Events, Law of Total Probability, Tree Diagrams, Bayes' Rule	2.4	Open tutorial: Topics TBA – *Piazza* Poll Friday, Sept. 27
Week 5 **(Sept. 30 - Oct. 4)**	Discrete Random Variables, Probability Mass Functions, Cumulative Distribution Functions, Functions of a Random Variable	3.1, 3.2, 3.3	**Quiz 2** to take place during tutorial period on Friday, Oct. 4 (to focus on Chapter 2 material)

Week	Key Topics	Sections	Notes
Week 6 **(Oct. 7 - 11)**	Expectation and Its Properties, Moments of a Distribution, Moment Generating Functions, Mean, Variance, Standard Deviation, Discrete Uniform Distribution	3.4, 3.5	**Term Test 1** to take place on Thursday, Oct. 10 from 4:45 to 6:15 pm (to cover material up to the end of Section 3.3) No tutorial to take place on Friday, Oct. 11
	READING WEEK (Saturday, October 12, 2024, to Sunday, October 20, 2024)		
Week 7 **(Oct. 21 - 25)**	Bernoulli Trials, Binomial Distribution, Hypergeometric Distribution, Geometric Distribution, Negative Binomial Distribution, Poisson Distribution	3.5	**Quiz 3** to take place during tutorial period on Friday, Oct. 25 (to focus on material from Section 3.4)
Week 8 **(Oct. 28 - Nov. 1)**	Joint Probability Mass Functions, Marginal Probability Mass Functions, Multinomial Distribution, Functions of Two or More Random Variables, Independent Random Variables	4.1, 4.2	Open Tutorial: Topics TBA – *Piazza* Poll Friday, Nov. 1

Week	Key Topics	Sections	Notes
Week 9 **(Nov. 4 - 8)**	Expectation and Its Properties, Covariance, Correlation, Linear Combinations of Random Variables, Indicator Random Variables, Conditional Probability Distributions	4.3, 4.4, 4.5	**Quiz 4** to take place during tutorial period on Friday, Nov. 8 (to focus on material from Sections 3.5, 4.1 & 4.2)
Week 10 **(Nov. 11 - 15)**	Law of Total Expectation, Continuous Random Variables, Probability Density Functions, Cumulative Distribution Functions, Functions of a Random Variable	4.6, 5.1, 5.2, 5.3	**Term Test 2** to take place on Thursday, Nov. 14 from 4:45 to 6:15 pm (to cover up to the end of Section 4.5) No tutorial to take place on Friday, Nov. 15
Week 11 **(Nov.18 - 22)**	Expectation and Its Properties, Moments of a Distribution, Moment Generating Functions, Mean, Variance, Standard Deviation, Continuous Uniform Distribution, Exponential Distribution, Normal Distribution	5.4, 5.5	Open Tutorial: Topics TBA – *Piazza* Poll Friday, Nov. 22
Week 12 **(Nov. 25 - 29)**	Markov's Inequality, Chebyshev's Inequality, Jensen's Inequality, Convergence in Probability, The Weak Law of Large Numbers, The Central Limit Theorem	6.1, 6.2, 6.3	**Quiz 5** to take place during tutorial period on Friday, Nov. 29 (to focus on material to the end of Chapter 5)

Week	Key Topics	Sections	Notes
Week 13 **(Dec. 2)**	Applications of the Central Limit Theorem	6.3	
Dec. 6-19	**Final Exam Period – Do not make travel plans until the final exam schedule has been posted**		

Texts / Materials

Title / Name	Notes / Comments	Required
STAT 230 Course Notes (Fall 2024 Edition)	Will be posted in an ongoing fashion on the course website on LEARN chapter by chapter	Yes

Out-of-Class Workload:

As in any university course, much of your learning will take place outside of class time. Each week, you have 3 hours of lectures. Therefore, you should plan to spend 3 to 6 hours each week in out-of-class learning. This learning consists mostly of making sure you understand the concepts and steps that were introduced and used in class to solve examples and then solving problems from the *Course Notes* on your own.

Missed Lectures:

If you miss lectures, then you are responsible for reaching out to a classmate in order to find out what was missed. Also, please note that instructors may annotate lecture slides during class time, but these annotations will generally **not** be available on LEARN (https://learn.uwaterloo.ca/d2l/home) after the lecture.

Student Assessment

Grading Scheme 1

Component	Value
Tutorial Quizzes (best 3 of 5)	15% (5% each)
Term Test 1	20%
Term Test 2	20%
Final Exam	45%

Grading Scheme 2

Component	Value
Tutorial Quizzes (best 3 of 5)	21% (7% each)
Best Term Test	27%
Worst Term Test	12%
Final Exam	40%

There are **two** grading schemes in place, so as to minimize the impact of a poor performance on either of the two term tests. (See below for details.)

All assessments will be graded and returned electronically using *Crowdmark*. If you have a question regarding the marking of an assessment, you should first check the posted solutions on the LEARN (https://learn.uwaterloo.ca/d2l/home) website. If you still have a question, then you should follow the procedure which will be posted on the LEARN (https://learn.uwaterloo.ca/d2l/home) website once an assessment has been graded and feedback has been returned to you. From the time an assessment is returned to you, you have one week to appeal a grade (no exceptions will be made for any reason).

Students must write BOTH term tests in order to qualify for Scheme 2. Otherwise, Scheme 1 will automatically be used. (See below for how your final grade is determined if you miss any term tests.) A student's final grade in STAT 230 is the maximum of the two grades calculated using Scheme 1 and Scheme 2.

A 2.5-hour final cumulative examination will be held during the final exam period, in December. **Please do not make any travel plans before the final exam schedule is posted.**

Information regarding the tutorial quizzes, term tests, and final exam (e.g., room locations) will be posted on the course website on LEARN (https://learn.uwaterloo.ca/d2l/home) .

Students must present a valid Student ID card to write all tutorial quizzes, term tests, and the final exam.

For the tutorial quizzes, term tests, and final exam, only a non-programmable, non-graphical, Math-faculty approved calculator with a pink-tie or blue goggle sticker will be allowed.

If you miss a **Tutorial Quiz** for whatever reason, there is no need to e-mail the instructor. Keep in mind that your Quiz Mark for the course will be comprised by taking your best 3 out of 5 quizzes.

If you miss a **Term Test** due to illness or extenuating circumstances, you must send an e-mail to Funmilayo Adeku at fadeku@uwaterloo.ca (mailto:fadeku@uwaterloo.ca) within 48 hours of the missed Term Test. For a missed Term Test with proper documentation, the weight will be shifted to the Final Exam.

If you miss the **Final Exam** due to illness or extenuating circumstances, you must send an e-mail to Funmilayo Adeku at fadeku@uwaterloo.ca (mailto:fadeku@uwaterloo.ca) within 48 hours of the missed Final Exam. If you miss the Final Exam with proper documentation, then the *Mathematics Faculty INC Grade Policy* (https://uwaterloo.ca/math/current-undergraduates/regulations-and-procedures/incomplete-procedure) will apply. Normally, if you have not earned a passing grade on your term work and you do not write the Final Exam, then you will receive a mark of DNW (Did Not Write) for the course.

Missed term tests without proper documentation are automatically awarded a grade of 0.

If you miss both term tests and you do not write the final exam, you will be ineligible for an INC. In this case, you will automatically receive a grade of DNW.

In the case of illness, you may declare your absence or submit a completed University of Waterloo Verification of Illness Form (VIF) to the Math Undergraduate Office, MC 4022. Remember that you must send an e-mail to Funmilayo Adeku at fadeku@uwaterloo.ca (mailto:fadeku@uwaterloo.ca) within 48 hours of a missed term test or final exam. No documentation is needed for a missed quiz, as we are taking your best 3 out of 5 quizzes.

See Faculty of Mathematics' Accommodations (https://uwaterloo.ca/math/accommodations/submission) webpage.

In the case of extenuating circumstances, you must provide sufficient documentation via e-mail to Funmilayo Adeku at fadeku@uwaterloo.ca (mailto:fadeku@uwaterloo.ca) as soon as possible to verify the circumstances surrounding your absence.

Assignment Screening

No assignment screening will be used in this course.

Administrative Policy

Intellectual Property and Copyright Notice:

Students should be aware that this course contains the intellectual property of their instructor, TA, and/or the University of Waterloo. Intellectual property includes items such as:

- Lecture content, spoken and written (and any audio/video recording thereof);
- Lecture handouts, presentations, and other materials prepared for the course;
- Questions or solution sets from various types of assessments (e.g., assignments, quizzes, tests, final exam); and
- Work protected by copyright (e.g., any work authored/used by the instructor/TA, with permission of the copyright owner).

These materials are made available for the personal use of students registered in the Fall 2024 offering of STAT 230. Students may not distribute or reproduce these materials for commercial or non-commercial means. Failure to abide by these conditions is a breach of copyright and an academic offence (see Policy 71 ((https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-71)).

Mental Health Support:

The Faculty of Math encourages students to seek out mental health support if needed.

- **On-campus Resources:**
  - Campus Wellness (https://uwaterloo.ca/campus-wellness/)
  - Counselling Services: counselling.services@uwaterloo.ca, 519-888-4567 ext. 32655
  - MATES: one-to-one peer support program offered by Waterloo Undergraduate Student Association (WUSA) and Counselling Services: mates@wusa.ca (mailto:mates@wusa.ca)
  - Health Services: located across the creek from the Student Life Centre, 519-888-4096.
- **Off-campus Resources:**

- Good2Talk (24/7): Free confidential help line for post-secondary students. Phone: 1-866-925-5454(Ontario and Nova Scotia only)
- Here 24/7: Mental Health and Crisis Service Team. Phone: 1-844-437-3247 (Waterloo Region only)
- OK2BME: set of support services for lesbian, gay, bisexual, transgender or questioning teens. Phone: 519-884-0000 extension 213 (Waterloo Region only)
- EMPOWER ME 1-833-628-5589 for CDN./USA other countries see: http://studentcare.ca/rte/en/IHaveAPlan_WUSA_EmpowerMe_EmpowerMe
- EMPOWER ME in China: China North 108007142831; China South 108001402851

Diversity:

It is our intent that students from all diverse backgrounds and perspectives be well served by this course, and that students' learning needs be addressed both in and out of class. We recognize the immense value of the diversity in identities, perspectives, and contributions that students bring, and the benefit it has on our educational environment. Your suggestions are encouraged and appreciated. Please let us know ways to improve the effectiveness of the course for you personally or for other students or student groups. In particular:

- We will gladly honour your request to address you by an alternate/preferred name or gender pronoun. Please advise us of this preference early in the semester so we may make appropriate changes to our records.
- We will honour your religious holidays and celebrations. Please inform of us these at the start of the course.
- We will follow AccessAbility Services guidelines and protocols on how to best support students with different learning needs.

Territorial Acknowledgement:

The University of Waterloo acknowledges that much of our work takes place on the traditional territory of the Neutral, Anishinaabeg, and Haudenosaunee peoples. Our main campus is situated on the Haldimand Tract, the land granted to the Six Nations that includes six miles on each side of the Grand River. Our active work toward reconciliation takes place across our campuses through research, learning, teaching, and community building, and is co-ordinated within the Office of Indigenous Relations. (https://uwaterloo.ca/indigenous)

Generative AI:

This course includes the independent development and practice of specific skills. Therefore, the use of Generative artificial intelligence (GenAI) trained using large language models (LLM) or other methods to produce text, images, music, or code, like Chat GPT, DALL-E, or GitHub CoPilot, is not permitted in this class. Unauthorized use in this course, such as running course materials through GenAI or using GenAI to complete a course assessment is considered a violation of Policy 71 (https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-71) (plagiarism or unauthorized aids or assistance). Work produced with the assistance of AI tools does not represent the author's original work and is therefore in violation of the fundamental values of academic integrity including honesty, trust, respect, fairness, responsibility and courage (ICAI (https://academicintegrity.org/images/pdfs/20019_ICAI-Fundamental-Values_R12.pdf) , n.d.).

You should be prepared to show your work. To demonstrate your learning, you should keep your rough notes, including research notes, brainstorming, and drafting notes. You may be asked to submit these notes along with earlier drafts of their work, either through saved drafts or saved versions of a document. If

the use of GenAI is suspected where not permitted, you may be asked to meet with your instructor or TA to provide explanations to support the submitted material as being your original work. Through this process, if you have not sufficiently supported your work, academic misconduct allegations may be brought to the Associate Dean.

In addition, you should be aware that the legal/copyright status of generative AI inputs and outputs is unclear. More information is available from the Copyright Advisory Committee: https://uwaterloo.ca/copyright-at-waterloo/teaching/generative-artificial-intelligence (https://uwaterloo.ca/copyright-at-waterloo/teaching/generative-artificial-intelligence)

Students are encouraged to reach out to campus supports if they need help with their coursework including:

- Student Success Office (https://uwaterloo.ca/student-success/resources) for help with skills like notetaking and time management
- Writing and Communication Centre (https://uwaterloo.ca/writing-and-communication-centre/services-0/services-undergraduate-students) for assignments with writing or presentations
- AccessAbility Services (https://uwaterloo.ca/accessability-services/students) for documented accommodations
- Library (https://uwaterloo.ca/library/research-supports/quick-start-guide) for research-based assignments

University Policy

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 the Office of Academic Integrity (https://uwaterloo.ca/academic-integrity/) for more information.]

Grievance: A student who believes that a decision affecting some aspect of their university life has been unfair or unreasonable may have grounds for initiating a grievance. Read Policy 70, Student Petitions and Grievances, Section 4 (https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-70) . 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 to avoid committing an academic offence, and to take responsibility for their actions. [Check the Office of Academic Integrity (https://uwaterloo.ca/academic-integrity/) for more information.] 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 (https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-71) . For typical penalties, check Guidelines for the Assessment of Penalties (https://uwaterloo.ca/secretariat/guidelines/guidelines-assessment-penalties) .

Appeals: A decision made or penalty imposed under Policy 70, Student Petitions and Grievances (https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-70) (other than a petition) or Policy 71, Student Discipline (https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-71) may be appealed if there is a ground. A student who believes they have a ground for an appeal should refer to Policy 72, Student Appeals (https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-72) .

Note for students with disabilities: AccessAbility Services (https://uwaterloo.ca/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.

Turnitin.com: Text matching software (Turnitin®) may be used to screen assignments in this course. Turnitin® is used to verify that all materials and sources in assignments are documented. Students' submissions are stored on a U.S. server, therefore students must be given an alternative (e.g., scaffolded assignment or annotated bibliography), if they are concerned about their privacy and/or security. Students will be given due notice, in the first week of the term and/or at the time assignment details are provided, about arrangements and alternatives for the use of Turnitin in this course.

It is the responsibility of the student to notify the instructor if they, in the first week of term or at the time assignment details are provided, wish to submit alternate assignment.