

# STAT 230 - Probability

## Fall 2018

### Course Syllabus

#### Course Website:

[learn.uwaterloo.ca](http://learn.uwaterloo.ca) You are expected to regularly read your UWaterloo email and visit the course website on Learn for announcements.

#### Instructors:

Section	Instructor	Email	Lecture Times & Room	Office Hour Times & Room
001	Jeff Wong	ty5wong	MWF 1:30-2:20, DC 1351	F 12:00-1:00, M3 4132
002 & 004	Adam Kolkiewicz	wakolkie	MWF 10:30-11:20, AHS 1689	M 3:30-4:30 F 11:30-12:30, M3 4009
003 (CS)	Diana Skrzydlo	dkchisho	MWF 9:30-10:20, DC 1350	MW 1:00-2:30, M3 3144
005	Yunran Wei	y27wei	MWF 8:30-9:20, MC 2017	MW 9:30-10:30, M3 4136

#### Office Hours:

You are encouraged to come to office hours if you have questions regarding the course material. When there are many students waiting to ask questions, a time limit of 10 minutes per student will be used. Students should come to office hours with clear and well-organized questions. TA office hours on Piazza will be posted on the course website on Learn. TA office hours "in office" will be only the weeks before the two midterms and the final exam.

#### Course Notes:

STAT 220/230/240 Course Notes (Fall 2018 Edition) by Chris Springer (revised by Jerry Lawless, Don McLeish and Cynthia Struthers) are posted on Learn and are available at the University Bookstore. These Course Notes are designed to complement the material covered in lectures.

#### iClickers:

We will be using iClickers in lectures to engage students and provide instant feedback. New iClickers can be purchased at the UW bookstore in South Campus Hall for around \$40. You can buy a used iClicker which is cheaper. You can also use iClicker Go or REEF for mobile devices, if you prefer.

When using your iClicker in the classroom, make sure you have set the frequency correctly. The frequency **must** be set at the beginning of **every** class. The frequency code for the classroom is a two letter combination that is usually posted on the wall near the front of the room. After you cast your vote, the *Vote Status* light on the clicker should flash green.

You must register your iClicker through the course website on Learn (Content->iClicker Registration) so that your clicker grades can be assigned. If you have problems with your clicker marks, please email the head TA. **Answering clicker questions for another student is an academic offence.**

#### Discussion Forum:

The discussion forum Piazza will be used to encourage discussion between students as well as discussion with the instructors and TAs. Please post your questions on the discussion forum instead of emailing the instructors or the TAs.

### Notes:

- You should receive an e-mail invite (to your @uwaterloo.ca address) from Piazza during the first two weeks of class. If you do not receive the email go to <https://piazza.com/uwaterloo.ca/fall2018/stat230>
- We will use Piazza solely for the discussion forum; announcements and all other material will be on the Stat 230 UW Learn webpage.
- Piazza is not a complaint forum so please do not post complaints there. If you have a concern about anything to do with the course, the best way to deal with it, and to get results, is to contact your instructor directly.
- Search for your question first before posting or check Learn for any questions not about course content.
- Make it easy for other students to find your question in case they have the same problem. For example in this course if you have a question about end-of-chapter problem 4.8 (d) then please put "Problem 4.8 (d)" in the subject line and be sure to click on the appropriate folder. Posts are organized by chapters in the Course Notes and by tests.
- When writing your question, please keep in mind that we will only answer if you have shown that you did some reasonable amount of work/thinking before asking your question. In the same spirit, our answer will most likely be some form of hint(s) that allow(s) you to move forward, as opposed to be the actual solution.
- If you so desire, you can post questions while remaining anonymous to your fellow classmates. To do so, click the Show up as Anonymous option. However, please note that instructors will be able to see your name.
- You are encouraged to answer other students' questions as this is a great way to solidify your own understanding. Bonus clicker marks may be awarded at the end of term for consistent high quality student answers.
- You can use LATEX in Piazza; click the fx button on the toolbar to use the LATEX Equation Editor, or start and end your LATEX code with  $\\$\\$$ .
- The Piazza help center can be found at: <https://piazza.com/support/help>; you can also e-mail Piazza's support team at: [team@piazza.com](mailto:team@piazza.com).

### Course Description:

This course provides students with 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.

### Course Objectives:

- To provide students with a basic understanding of probability, random variables and expectation.
- To provide students with knowledge of the physical setups for the named distributions including the Hypergeometric, Binomial, Negative Binomial, Geometric, Uniform, Exponential and Normal.
- To provide students with learning/metacognitive skills to apply in this and other courses

### Pre-requisites:

To take this course you need to have (MATH 135 with min. grade of 60% or MATH 145) & (MATH 128 with min. grade of 70% or (MATH 117 or 137) with min. grade of 60% or MATH 147)); Level at least 1B Hon. Math or Math/Phys students only.

Corequisite: MATH 119or138or148.

### 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 to stat 231, you only need a pass (50%) in STAT 230. However to take upper-year STAT courses such as 330, 333, 334, or 340 you need 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' theorem;
- distinguish between discrete and continuous random variables;
- define and use probability functions/probability density functions and cumulative distribution functions to determine probabilities of events;
- define and use joint probability functions, marginal probability functions, and conditional probability functions to determine the probabilities of events for two or more discrete random variables;
- use the named distributions (Discrete Uniform, Hypergeometric, Binomial, Negative Binomial, Geometric, Poisson, Continuous Uniform, Exponential, Normal (Gaussian), and Multinomial) to model real phenomena;
- calculate and interpret means, variances and covariances particularly for the named distributions;
- define the Central Limit Theorem and use it to approximate probabilities;
- find moment generating functions for the named distributions and use the moment generating function to determine expectations.
- understand your own learning style and develop your learning skills

### Missed Lectures:

If you miss lectures then you are responsible for finding out from a classmate what you missed. Your instructor will not reteach the lectures you have missed.

### Calculator Policy:

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

### Remarking of Tests:

If you have a question regarding the marking of a test you must first check the posted solutions. If you still have a question then you should follow the procedure posted on the course website. **You have one week to appeal a test grade.**

### Out-of-Class Workload:

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

## Grading Scheme:

Every student in every section is treated the same way according to the grading scheme below. We cannot modify final grades to give you an extra percent – this would be unfair to the other students.

There are 2 grading schemes in order to minimize the impact of a poor performance on either of the 2 midterms:

### Scheme 1

Best 4 of: 20% (5% each)

- Clicker Questions
- Tutorial Test 1
- Tutorial Test 2
- Tutorial Test 3
- Total on 3 Tut Assignments

Midterm Test 1: 15%

Midterm Test 2: 15%

Final Exam: 50%

### Scheme 2

Best 4 of: 20% (5% each)

- Clicker Questions
- Tutorial Test 1
- Tutorial Test 2
- Tutorial Test 3
- Total on 3 Tut Assignments

Best Midterm Test: 15%

Worst Midterm Test: 5%

Final Exam: 60%

**Students must write both midterm tests in order to qualify for Scheme 2.** (See below for how your final grade is determined if you miss any tests.) A student's final grade is the maximum of the two grades calculated using Scheme 1 and Scheme 2.

## Clicker Grades:

For each clicker question asked during class, there will be two marks: one for answering (any answer), and another for a correct response. Only the best 75% of the clicker marks will be used to determine your clicker grade.

Instructors may ask different number of questions in each class, but in the end your mark is:  $\frac{\# \text{ of marks you earned}}{0.75 \times \# \text{ of marks possible}}$

## Tutorial Assignments:

There are 3 scheduled assignments in your scheduled tutorials on **Sept 21, Oct 26, and Nov 23**. The Tutorial Assignments will be open book and you may work with others. Instructors and TAs will be present to help. **You must attend the tutorial section you are registered in to receive the assignments marks.** If you miss any of these assignments for any reason you will get zero.

## Tutorial Tests:

There will be 3 Tutorial Tests held during your scheduled tutorials on **Sept 28, Nov 2, and Nov 30**. **You may only write your Tutorial Test in your assigned tutorial time.** If you miss just one tutorial test you do NOT need to provide documentation or VIF, because your lowest Tutorial Test mark will be dropped automatically. If you miss two tutorial tests or more, then you must provide proper documentation to your instructor within 48 hours of the last missed test.

## Other Tutorials:

There are 3 optional tutorials. The first one is a workshop on study skills and metacognition, and the other two are post-midterm discussions. You do not have to attend but students who have attended similar workshops in the past have said they were extremely useful, so you are encouraged to attend.

## Midterm Tests:

There will be 2 Midterm Tests.

Midterm Test 1: **Thursday, October 4, 4:40 - 6:10 pm.**

Midterm Test 2: **Thursday, November 8, 4:40 - 6:10 pm.**

## Final Examination:

A 2.5 hour final cumulative examination will be held during the final exam period, December 6-21.

Please do not make any travel plans before the final exam schedule is posted.

Information regarding the tutorial tests, midterm tests, and final exam (e.g. material covered and locations) will be posted on the course website on Learn.

## Missed Tutorial Tests, Midterm Tests or Final Exam:

- If you miss a midterm test or final exam due to illness or extenuating circumstances you must provide proper documentation to your instructor within 48 hours of the missed test or final exam. In the case of illness you must provide a completed University of Waterloo Verification of Illness form.  
See: <https://uwaterloo.ca/health-services/sites/ca.health-services/files/uploads/files/VIF-online.pdf>  
In the case of extenuating circumstances you must provide sufficient documentation to your instructor to verify the circumstances.
- Missed tutorial and midterm tests without proper documentation are awarded a grade of 0.
- If you miss both midterms (regardless of documentation) you will automatically receive a grade of DNW. Therefore you should withdraw from the course.  
See <https://uwaterloo.ca/math/current-undergraduates/undergraduate-faq/dropping-courses>.
- If you miss Midterm Test 1 or 2 (but not both) due to illness/extenuating circumstances with proper documentation then your Final Exam grade will count for 65% of your final grade.
- If you miss two or more tutorial tests due to illness/extenuating circumstances with proper documentation, 5% weight will be added to the final exam for the second (and third if applicable) test missed.
- If you miss the final exam due to illness/extenuating circumstances with proper documentation then the Mathematics Faculty INC Grade Policy (see below) will apply. 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 for the course.

## University of Waterloo and Mathematics Faculty Policies

All instructors and students must follow the following academic policies:

**Academic Integrity:** In order to maintain a culture of academic integrity, member of the University of Waterloo community are expected to promote honesty, trust, fairness, respect and responsibility.

See: [www.uwaterloo.ca/academicintegrity/](http://www.uwaterloo.ca/academicintegrity/) for more information.

**Discipline:** A student is expected to know what constitutes academic integrity to avoid committing an academic offence, and to take responsibility for their 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](http://www.adm.uwaterloo.ca/infosec/Policies/policy71.htm).

See: [www.adm.uwaterloo.ca/infosec/guidelines/penaltyguidelines.htm](http://www.adm.uwaterloo.ca/infosec/guidelines/penaltyguidelines.htm) for guidelines for the assessment of penalties.

**Avoiding Academic Offenses:** For more information on commonly misunderstood academic offenses and how to avoid them, students should refer to the Faculty of Mathematics Cheating and Student Academic Discipline Policy.

See: [http://www.math.uwaterloo.ca/navigation/Current/cheating\\_policy.shtml](http://www.math.uwaterloo.ca/navigation/Current/cheating_policy.shtml).

**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. See Policy 70, Student Petitions and Grievances, Section 4: <https://uwaterloo.ca/secretariat-general-counsel/policies-procedures-guidelines/policy-70>. When in doubt, please contact the department's administrative assistant who will provide further assistance.

**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 they have a ground for an appeal should refer to Policy 72 (Student Appeals).

See: [www.adm.uwaterloo.ca/infosec/Policies/policy72.htm](http://www.adm.uwaterloo.ca/infosec/Policies/policy72.htm).

**Mathematics Faculty INC Grade Policy:** A grade of INC is awarded to a student who has completed course work during the term well enough that they could reasonably be expected to earn a passing mark in the course, but who was unable to complete end-of-term course requirements (usually the final exam) for reasons beyond their control. See: <http://www.math.uwaterloo.ca/navigation/Current/inc.procedure.shtml>.

### AccessAbility Services:

AccessAbility Services, located in Needles Hall, Room 1132, 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 the AccessAbility Services at the beginning of each academic term.

### Counselling Services and the Student Success Office:

If you need some help during the term with study skills or dealing with personal issues, please make use of the resources that are available to help you. The Student Success Office's mandate is to provide and facilitate strategic student support for academic and personal success. It is located on the second floor of South Campus Hall and you can reach them by email at [success@uwaterloo.ca](mailto:success@uwaterloo.ca). Counselling Services has offices in MC and many other buildings on campus, in addition to their main offices in the Needles Hall expansion and in Health Services. Find more information about their services here: <https://uwaterloo.ca/counselling-services/services>

### Course Schedule:

The following table gives a tentative schedule for the material covered with sections in the Course Notes indicated, as well as any tutorials, assignments, tests, and midterms. Note that we have one extra lecture in week 5 so you get the whole week 6 off.

Week	Topics	Sec.	Notes
1. September 6-7	Introduction Definitions of Probability Chapter 1 Problems	1.1 1.2	No Tutorial
2. September 10-14	Experiment, Sample Space, Simple and Compound Events, Probability Distribution, Probability of an Event Chapter 2 Problems Addition and Multiplication Rules Counting Arrangements or Permutations Counting Subsets of Combinations	2.1 2.2 3.1 3.2 3.3	Optional Tutorial: study skills and meta-cognition Friday Sept 14
3. September 17-21	Number of Arrangements when symbols are repeated Examples Chapter 3 Problems Review of Set Theory, De Morgan's Laws, Rules for Determining the Probability of an Event Rules for Unions of Events, Mutually Exclusive Events Independent Events	3.4 3.5 3.6 4.1 4.2 4.3	<b>Tutorial Assignment 1</b> <b>Friday Sept 21</b>
4. September 24 -28	Conditional Probability Product Rule, Law of Total Probability, and Bayes' Theorem Review of Useful Series Chapter 4 Problems Random Variables: Probability Functions and Their Properties, Cumulative Distribution Functions and Their Properties	4.4 4.5 4.6 4.7 5.1	<b>Tutorial Test 1</b> <b>Friday Sept 28</b>
5. October 1- 5	Discrete Uniform Distribution Hypergeometric Distribution Bernoulli Trials, Binomial Dist, Binomial Approx to Hypergeometric Negative Binomial Distribution Geometric Distribution	5.2 5.3 5.4 5.5 5.5	<b>Midterm Test 1</b> <b>Thursday Oct 4</b> <b>4:40 - 6:10pm</b>  Extra Lecture in Tutorial
6. October 11-12	<b>Oct 8-10 Fall Break, Class Cancelled on Fri Oct 12</b>		<b>Have a great break!</b>



7. October 15-19	Poisson Distribution from Binomial Poisson Distribution from Poisson Process Combining Models Summary of Discrete Distributions Chapter 5 Problems	5.7 5.8 5.9 5.10 5.11	Optional Tutorial: Midterm 1 Review
8. October 22-26	Summarizing Data on Random Variables Expectation of a Random Variable, Expectation of a Function of a Random Variable, Properties of Expectation Some Applications of Expectation Variance and Its Properties, Means and Variances of Named Distributions Chapter 7 Problems	7.1 7.2  7.3 7.4  7.5	<b>Tutorial Assignment 2</b> <b>Friday Oct 26</b>
9. October 29- November 2	Continuous Random Variables: Cumulative Distribution Function and Its Properties, Probability Density Function and Its Properties, Change of Variable. Expectation, Mean and Variance Continuous Uniform Distribution	8.1  8.2	<b>Tutorial Test 2</b> <b>Friday Nov 2</b>
10. November 5-9	Exponential Distribution, Gamma Function, Memoryless Property Normal (Gaussian) Distribution, Standard Normal Tables Chapter 8 Problems	8.3 8.5 8.6	<b>Midterm Test 2</b> <b>Thursday Nov 8</b> <b>4:40 - 6:10pm</b> No Tutorial
11. November 12-16	Multivariate Distributions: Joint Probability Function, Marginal Probability Functions, Independent Random Variables, Conditional Probability Functions, Functions of Two or More Random Variables Multinomial Distribution: Joint Probability Function, Marginal and Conditional Probability Functions	9.1  9.2	Optional Tutorial: Midterm 2 Review
12. November 19-23	Expectations for Multivariate Distributions, Covariance and Correlation Coefficient and Their Interpretations Mean and Variance of a Linear Combination of Random Variables, Indicator Random Variables Linear Combinations of Independent Normal Random Variables Chapter 9 Problems	9.4  9.5 9.6 9.7 9.8	<b>Tutorial Assignment 3</b> <b>Friday Nov 23</b>
13. November 26-30	Central Limit Theorem and Approximations, Normal Approximation to Binomial and Poisson Distributions Moment Generating Functions Chapter 10 Problems	10.1  10.2 10.4	<b>Tutorial Test 3</b> <b>Friday Nov 30</b>
14. December 3	Last day of classes – review/summary or catch-up		
Final Exam Period December 6-21			<b>Final Exam</b> <b>Date TBA</b>

### Course Concept Map:

