

# STAT 230 - Probability

## Fall 2014

### Course Syllabus

#### The Course Information Page:

[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:

| Sec | Instructor       | Office  | Email          | Lecture Times        |
|-----|------------------|---------|----------------|----------------------|
| 001 | Steve Drekcic    | M3 3117 | sdrekcic       | 12:30MWF DC1350      |
| 002 | Steve Drekcic    | M3 3117 | sdrekcic       | 9:30MWF DC1350       |
| 003 | Andrei Fajardo   | M3 4129 | andrei.fajardo | 4:30MWF MC2066       |
| 004 | Changbao Wu      | M3 4212 | cbwu           | 8:30MWF STP 105      |
| 005 | Cyntha Struthers | M3 3129 | castruth       | 4:30-5:50MW STJ 3014 |

#### Office Hours:

Instructor and TA office hours will be posted on LEARN. TA office hours take place in M3 3106, 3108, 3111. 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.

#### Discussion Forum:

The discussion forum Piazza will be used to encourage discussion between students as well as discussion with the instructors and TA's. Please post your questions on the discussion forum instead of emailing the instructors or the TA's. To join the Piazza forum go to <https://piazza.com/uwaterloo.ca/fall2014/stat230/home>. We will only use Piazza for the discussion forum. **Announcements and all other material will be posted on LEARN.** The Piazza forum is for asking questions about course material. If your question/concern is more personal (e.g., illness), please e-mail your instructor.

#### Course Notes:

STAT 220/230/240 Course Notes (Fall 2014 Edition) by Chris Springer (revised by Jerry Lawless, Don McLeish and Cyntha Struthers) are posted on LEARN and are available at the University Bookstore. These Course Notes are designed to complement the material covered in lectures.

#### Course Description:

This course provides an introduction to probability. Topics include the laws of probability, discrete and continuous random variables, expectation and the Central Limit Theorem.

#### 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.

#### Pre-requisites:

To take this course you need to have obtained a grade of at least 60% in MATH 137 (or 70% in MATH 127 or MATH 128) and be at a level of at least 1B Honours Math. MATH 138 (or 128 or 148) is a co-requisite for this course.

## 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.

## 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.

## 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.

## 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 3/4 hours of lectures/tutorial. Therefore you should plan to spend between 3 and 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**

Tutorial Tests – 15%  
Midterm Test 1 – 15%  
Midterm Test 2 – 15%  
Final Exam – 55%

### **Scheme 2**

Tutorial Tests – 15%  
Best Midterm Test – 15%  
Worst Midterm Test – 5%  
Final Exam – 65%

**Students must write both midterm tests in order to qualify for this maximum scheme.** (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. If a grade of 0 is assigned to a test due to an academic offense then only Scheme 1 will be used.

## **Tutorial Tests:**

Please check your schedule for your assigned tutorial time. There will be 3 Tutorial Tests held during your scheduled tutorial time. See the course schedule below. **You may only write your Tutorial Test in your assigned tutorial time.**

Two of the 3 questions on each Tutorial Test will be taken and sometimes modified slightly from the end-of-chapter problems in the Course Notes.

## **Tutorials:**

During the weeks when there is no Tutorial Test, scheduled tutorials will be conducted by one of the course instructors. See the course schedule below. Examples will be presented in these tutorials to supplement the material covered in lectures. **Students are urged to attend these tutorials in order to be prepared for the tests and final exam.**

## **Midterm Tests:**

There will be 2 Midterm Tests. Two of the questions on each Midterm Test will be taken and sometimes modified from the end-of-chapter problems in the Course Notes.

## **Test dates:**

Midterm Test 1: Thursday October 9, 2014, 4:30-6:00 pm.

Midterm Test 2: Thursday November 13, 2014, 4:30-6:00 pm.

## **Final Examination:**

A 2.5 hour final cumulative examination will be held during the final exam period, December 4-19.

**Details regarding the tests and final exam (e.g. material covered and locations) will be announced in class and posted on Learn.**

**Students must present a valid Student ID card to write all tests and final exam.**

## **Calculator Policy:**

For the tests and final exam, only a non-programmable, non-graphical, math faculty approved calculator with a **pink-tie sticker** 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 please write a clear question on a separate piece of paper, attach it to your test and give it to the Head TA for the course. **You have 7 days to appeal a test grade.**

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

If you miss a 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 automatically 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://math.uwaterloo.ca/math/promotional-item/undergraduate-faq/dropping-courses>.

If you miss Tutorial Test 1 due to illness/extenuating circumstances with proper documentation then your Tutorial Test 1 grade out of 5 equals your Midterm Test 1 grade out of 5.

If you miss Tutorial Test 2 due to illness/extenuating circumstances with proper documentation then your Tutorial Test 2 grade out of 5 equals your Midterm Test 2 grade out of 5.

If you miss Tutorial Test 3 due to illness/extenuating circumstances with proper documentation then your Tutorial Test 3 grade out of 5 equals your Final Exam grade out of 5.

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 70% of your final grade.

If you miss Tutorial Test 1 and Midterm 1 (but not Midterm 2) due to illness/extenuating circumstances with proper documentation then your Final Exam will count for 75% of your final grade.

If you miss Tutorial Test 2 and Midterm 2 (but not Midterm 1) due to illness/extenuating circumstances with proper documentation then your Final Exam will count for 75% of your final grade.

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. 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 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 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](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 his/her 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 he/she has 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 his or her 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.

### Course Schedule:

The following table gives a tentative schedule for the material covered with sections in Course Notes indicated. The weeks for tutorials, tutorial tests, and midterm tests are also indicated. October 13 is Thanksgiving Day.

| Week               | Topics                                                                                                                                                                                                                                                                    | Sec.                     | Notes                              |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|------------------------------------|
| 1. Sept. 8-12      | Definitions of Probability<br>Chapter 1 Problems<br>Experiment, Sample Space, Simple and Compound Events,<br>Probability Distribution, Probability of an Event<br>Chapter 2 Problems                                                                                      | 1.1<br>1.2<br>2.1<br>2.2 | No Tutorial                        |
| 2. Sept. 15-19     | Addition and Multiplication Rules, Equiprobable Outcomes, Combinatorial<br>Symbols, Permutations and Combinations<br>Review of Useful Series<br>Chapter 3 Problems                                                                                                        | 3.1<br>3.2<br>3.3        | Tutorial                           |
| 3. Sept. 22-26     | Review of Set Theory, De Morgan's Laws, Rules for Determining the<br>Probability of an Event<br>Rules for Unions of Events, Mutually Exclusive Events<br>Independent Events<br>Conditional Probability                                                                    | 4.1<br>4.2<br>4.3<br>4.4 | Tutorial Test 1<br>Friday Sept. 26 |
| 4. Sept. 29-Oct. 3 | Product Rule, Law of Total Probability, Bayes' Theorem<br>Chapter 4 Problems<br>Random Variables: Probability Functions for Discrete<br>Random Variables and Their Properties, Cumulative Distribution<br>Functions and Their Properties<br>Discrete Uniform Distribution | 4.5<br>4.6<br>5.1<br>5.2 | Tutorial                           |

|                |                                                                                                                                                                                                                                                                                                                                             |                                     |                                                  |
|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|--------------------------------------------------|
| 5. Oct. 6-10   | Hypergeometric Distribution<br>Bernoulli Trials, Binomial Distribution, Binomial Approximation to Hypergeometric Distribution<br>Negative Binomial Distribution<br>Geometric Distribution<br>Poisson Distribution from Binomial Distribution                                                                                                | 5.3<br>5.4<br><br>5.5<br>5.6<br>5.7 | Midterm Test 1<br>Thursday Oct. 9<br>No Tutorial |
| 6. Oct. 15-17  | Poisson Distribution from Poisson Process<br>Combining Models<br>Summary of Discrete Distributions<br>Chapter 5 Problems                                                                                                                                                                                                                    | 5.8<br>5.9<br>5.10<br>5.11          | Thanksgiving<br>Tutorial                         |
| 7. Oct. 20-24  | Expectation of a Random Variable, Expectation of a Function of a Random Variable, Properties of Expectation<br>Applications<br>Variance and Its Properties, Means and Variances of Named Distributions<br>Chapter 7 Problems                                                                                                                | 7.2<br><br>7.3<br>7.4<br><br>7.5    | Tutorial                                         |
| 8. Oct. 27-31  | Continuous Random Variables: Cumulative Distribution Function and Its Properties, Probability Density Function and Its Properties, Change of Variable, Expectation, Mean and Variance<br>Continuous Uniform Distribution<br>Exponential Distribution, Gamma Function, Memoryless Property                                                   | 8.1<br><br>8.2<br>8.3               | Tutorial Test 2<br>Friday Oct. 31                |
| 9. Nov. 3-7    | Normal (Gaussian) Distribution, Standard Normal Tables<br>Chapter 8 Problems<br>Multivariate Distributions: Joint Probability Function, Marginal Probability Functions, Independent Random Variables                                                                                                                                        | 8.4<br>8.5<br>9.1                   | Tutorial                                         |
| 10. Nov. 10-14 | Multivariate Distributions Continued: Conditional Probability Functions, Functions of Two or More Random Variables<br>Multinomial Distribution: Joint Probability Function, Marginal and Conditional Probability Functions<br>Expectations for Multivariate Distributions, Covariance and Correlation Coefficient and Their Interpretations | 9.1<br><br>9.2<br><br>9.4           | Midterm Test 2<br>Thursday Nov. 13               |
| 11. Nov. 17-21 | Mean and Variance of a Linear Combination of Random Variables, Indicator Random Variables<br>Linear Combinations of Independent Normal Random Variables<br>Chapter 9 Problems                                                                                                                                                               | 9.5<br><br>9.6<br>9.7               | Tutorial                                         |
| 12. Nov. 24-28 | Central Limit Theorem and Approximations, Normal Approximation to Binomial and Poisson Distributions<br>Moment Generating Functions                                                                                                                                                                                                         | 10.1<br><br>10.2                    | Tutorial Test 3<br>Friday Nov. 28                |
| 13. Dec. 1     | Chapter 10 Problems                                                                                                                                                                                                                                                                                                                         | 10.4                                | Last Class                                       |



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