1 Contact Information

- **Instructor**: Professor Ambrose Lo, PhD, FSA, CERA
  - **Office**: 368 SH
  - **Phone**: (319) 335-1915
  - **Email**: ambrose-lo@uiowa.edu
    (Note: Please put “STAT:4510” in the subject line)
  - **Office hours**: 2:30 p.m. – 3:30 p.m., Wednesday, Thursday, Friday, and by appointment

- **Grader**: Mr. Rui Huang
  - **Office**: 266 SH
  - **Phone**: (319) 335-2078
  - **Email**: rui-huang-2@uiowa.edu
    (Note: Please put STAT:4510” in the subject line)

- **DEO**: Professor Joseph B. Lang
  - **Office**: 241 SH
  - **Phone**: (319) 335-0712
  - **Email**: joseph-lang@uiowa.edu

2 Course Description and Objectives

This applied statistics course for B.S. and M.S. in Actuarial Science students covers the theory and applications of general linear models, generalized linear models (as exemplified by logistic
regression models), and regression-based time series models. Emphasis is placed on the parameter estimation, variable selection, and diagnostic checking for these models, and their use for statistical inference and prediction. If time permits, practical implementations of these models with real data in actuarial and financial contexts will be demonstrated. Most importantly, the course satisfies the Validation by Educational Experience (VEE) requirement for Applied Statistical Methods of the Society of Actuaries (SOA). Provided that you get a B- or above in this course, you will be entitled to receive the VEE credit in Applied Statistics.

Structure-wise, the course consists of the following three central themes in statistical modeling:

**Theme I. Linear Regression (approx. 7 weeks)**

**Theme II. Logistic Regression (approx. 2 weeks)**

**Theme III. Introductory Time Series Analysis (approx. 6 weeks)**

The detailed course contents align closely with the following topics stipulated by the SOA: (see the guidelines from the SOA attached to this syllabus)

<table>
<thead>
<tr>
<th>Regression analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Least square estimates of parameters</td>
</tr>
<tr>
<td>• Simple linear regression</td>
</tr>
<tr>
<td>• Multiple linear regression</td>
</tr>
<tr>
<td>• Hypothesis testing and confidence intervals in linear regression models</td>
</tr>
<tr>
<td>• Testing of models, data analysis and appropriateness of models</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time series/forecasting</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Linear time series models</td>
</tr>
<tr>
<td>• Moving average, regression-based and/or ARIMA models</td>
</tr>
<tr>
<td>• Estimation, data analysis and forecasting with time series models</td>
</tr>
<tr>
<td>• Forecast errors and confidence intervals</td>
</tr>
</tbody>
</table>

Note that this course emphasizes not only being able to make sense of the summarized results from a given statistical model, but also the mathematical rationale behind the construction of various hypothesis tests and point/interval forecasts. By strongly discouraging the black-box approach adopted by conventional regression courses, this course will inculcate students with a genuine understanding of why a particular statistical methodology works or does not work. If you have already fulfilled the VEE Applied Statistics requirement and desire a less technical course, consider taking STAT:3200 (Applied Linear Regression) instead.

After completing the course, you should be able to:

- Understand the ideas and assumptions behind the statistical methods covered in the course
- Apply the methods (linear regression in particular) to real-world problems that are amenable to such techniques
- Interpret the results from a statistical analysis
3 CAS Exam S

Students who aspire to specialize in property and casualty (P&C) will take Exam S (Statistics and Probabilistic Models) of the Casualty Actuarial Society (CAS), Sections C and D of which will be partially covered in this course. In Fall 2017, Exam S will take place on October 26, 2017 (Thursday). The registration deadline is August 31. More information about Exam S (e.g. syllabus, sample questions) can be found at [http://www.casact.org/admissions/syllabus/index.cfm?fa=Ssyllabi&parentID=345](http://www.casact.org/admissions/syllabus/index.cfm?fa=Ssyllabi&parentID=345).

4 Texts

As in ACTS:4380, there are no required textbooks in this course. We shall follow closely the course lecture notes, regarded as a mini-textbook, which will be handed out in class and made available on ICON ([http://icon.uiowa.edu](http://icon.uiowa.edu)) chapter by chapter. These notes represent the instructor's personal summaries of the subject synthesized from different sources, some of which include:


   Written by a renowned actuarial science professor in the University of Wisconsin–Madison, this textbook is adopted by a number of courses for VEE Applied Statistics in North America. The main attraction of this book is that it is geared towards actuarial students with frequent references to actuarial applications. However, it suffers from a relatively terse treatment of time series analysis. Chapters 1–8 and 11 of this book are particularly germane to Parts I and II of this course respectively.


   This lesser-known text is characterized by its exceptionally lucid exposition on regression analysis. Its downsides are that it tends to skip mathematical proofs and that it lacks exercises. Both deficiencies are remedied by the course notes. Chapters 3 and 6 of this book pertain to Parts I and II of this course respectively.

3. *Introduction to Regression Modeling*, 2006, by Bovas Abraham and Johannes Ledolter

   This technically oriented book is the required textbook of STAT:5200 (Applied Statistics I) offered to M.S. in Statistics students of our department. It is suitable for students who are deeply interested in the mathematical aspects of regression analysis. Read Chapters 2 to 7 of the book if you are interested.


   This is the required textbook for the time series portion of CAS Exam S. Note that our treatment of time series analysis will be at a level higher than that of this book.


Being the required textbook of STAT:6560 (Applied Time Series Analysis) offered to advanced statistics undergraduates and MS in Statistics students of our department, this is an intermediate-level textbook on time series analysis written by two celebrated UI Statistics professors.


5 Grading System

Assessment in this course comprises the following items:

1. **Attendance and participation: 10%**

   Everyone should be able to score all of these 10 points by regularly attending and paying attention in lectures. If you are absent from any class without a valid reason, it is impossible to get a copy of any course material you miss and inquire about any announcements made in class.

2. **Assignments: 20%**

   There will be weekly assignments consisting of a few end-of-chapter problems in the lecture notes, usually assigned on Wednesday and due the following Wednesday. A few assignment problems may require some simple data analysis, which you can complete using any computer software (even Excel is good enough!). Late homework will be severely penalized (see the instructions on the assignment sheet). For students’ edification, illustrative solutions will be posted on ICON shortly after each homework is due.

   A note on collaboration: Discussion with other students on homework problems is encouraged. However, what you hand in must ultimately be your own work.

3. **Midterm Examination: 30%**

   There will be a two-hour written Midterm Examination to be held in the evening (6:30 p.m. – 8:30 p.m.) of **November 3, 2017 (Friday)** at 140 SH covering Part I (Linear Regression) of this course. It will consist of a mixture of short and structured questions which emphasize how to make use of summarized model output to perform statistical inference. You will find that end-of-chapter problems in the lecture notes are useful in preparing for the Midterm Exam.

4. **Short Quizzes: 4%**

   There will be two 15-minute quizzes held after the Midterm Exam (and the MLC exam). These quizzes are intended to make sure that you stay up with the course content by studying regularly (not just cram before the Final Exam!) and will consist of relatively straightforward questions.
5. **Final Examination: 36%**

A two-hour comprehensive written Final Examination will take place in the week of December 11–15, 2017. Like the Midterm Exam, the Final Exam comprises a mixture of short and structured questions. The exact date and time will be announced by the Registrar in mid-September. Please do not plan your end-of-semester travel plans until the final exam schedule is made public. It is your responsibility to know the date, time, and place of the Final Exam.

All quizzes and exams in this course are closed-book. However, unlike ACTS:4380, a formula sheet will be provided for both the Midterm Exam and Final Exam. Still only SOA/CAS-approved calculators listed on Point 9 of [https://www.soa.org/Files/Edu/edu-rules-reg-instructions.pdf](https://www.soa.org/Files/Edu/edu-rules-reg-instructions.pdf) are allowed.

**Note on absence from exams.** If, for medical reasons, you are unable to take any exam in this course, you should inform the course instructor within 48 hours of the exam, and submit original documentation as soon as possible. Otherwise, a zero score will be awarded. Absence for other reasons will not be allowed, unless approval from the instructor is sought well in advance.

**Grading scheme.** Plus or minus grades will be given in this course, and undergraduate and graduate students will be treated as two separate groups when it comes to assigning final grades. An approximate guide is as follows:

<table>
<thead>
<tr>
<th>Undergraduate students</th>
<th>Graduate students</th>
</tr>
</thead>
<tbody>
<tr>
<td>A- [83.5, 89)</td>
<td>A- [85, 90)</td>
</tr>
<tr>
<td>A [89, 94.5)</td>
<td>A [90, 95)</td>
</tr>
<tr>
<td>A+ [94.5, 100]</td>
<td>A+ [95, 100]</td>
</tr>
<tr>
<td>B- [67, 72.5)</td>
<td>B- [70, 75)</td>
</tr>
<tr>
<td>B [72.5, 78)</td>
<td>B [75, 80)</td>
</tr>
<tr>
<td>B+ [78, 83.5)</td>
<td>B+ [80, 85)</td>
</tr>
<tr>
<td>C- [50.5, 56)</td>
<td>C- [55, 60)</td>
</tr>
<tr>
<td>C [56, 61.5)</td>
<td>C [60, 65)</td>
</tr>
<tr>
<td>C+ [61.5, 67)</td>
<td>C+ [65, 70)</td>
</tr>
<tr>
<td>D- [34, 39.5)</td>
<td>D- [40, 45)</td>
</tr>
<tr>
<td>D [39.5, 45)</td>
<td>D [45, 50)</td>
</tr>
<tr>
<td>D+ [45, 50.5)</td>
<td>D+ [50, 55)</td>
</tr>
<tr>
<td>F [0,34)</td>
<td>F [0,40)</td>
</tr>
</tbody>
</table>

These are not completely absolute scales and the instructor reserves the “option” to adjust the cutoffs. Note that with this grading scheme you are not “graded on a curve”, and so you are not competing with fellow students. Therefore, you are not penalized in any way for working together to better understand concepts and to perform better in this course.

**IMPORTANT NOTE**

This is not an easy course for most students, even if you have prior exposure to regression analysis. Each week you should spend about 3 hours outside of class meetings reviewing the course notes and working on the end-of-chapter problems. It is fine to work harder, but working less is risky. Let me know if you encounter any problems with your learning.
More about the instructor (“Shameless” self-introduction...)

Professor Ambrose Lo was born (in 19X9), raised, and educated in Hong Kong. He earned his B.S. in Actuarial Science (first class honors) and Ph.D. in Actuarial Science from The University of Hong Kong in 2010 and 2014 respectively. He joined the Department of Statistics and Actuarial Science at The University of Iowa in August 2014 as an Assistant Professor in Actuarial Science. He is a Fellow of the Society of Actuaries (FSA) and a Chartered Enterprise Risk Analyst (CERA). His research interests lie in dependence structures, quantitative risk management as well as optimal (re)insurance. His research papers have been published in top-tier actuarial journals, such as *Insurance: Mathematics and Economics, Scandinavian Actuarial Journal* and *ASTIN Bulletin: The Journal of the International Actuarial Association*.

Besides dedicating himself to actuarial research, Ambrose attaches equal importance to teaching, through which he nurtures the next generation of actuaries and serves the actuarial profession. He has taught courses on financial derivatives, mathematical finance, life contingencies, credibility theory, advanced probability theory, and regression analysis. His emphasis in teaching is always placed on thorough understanding of the subject matter complemented by concrete problem-solving skills. He is also the sole author of the 1370-page ACTEX CAS Exam S Study Manual (Fall 2017 Edition).
The College of Liberal Arts & Sciences:  
Important Policies and Procedures

Administrative Home

The College of Liberal Arts and Sciences is the administrative home of this course and governs matters such as the add/drop deadlines, the second-grade-only option, and other related issues. Different colleges may have different policies. Questions may be addressed to 120 Schaeffer Hall, or see the CLAS Academic Policies Handbook at http://clas.uiowa.edu/students/handbook.

Electronic Communication

University policy specifies that students are responsible for all official correspondences sent to their University of Iowa e-mail address (@uiowa.edu). Faculty and students should use this account for correspondences (Operations Manual, III.15.2, k.11).

Accommodations for Disabilities

The University of Iowa is committed to providing an educational experience that is accessible to all students. A student may request academic accommodations for a disability (which includes but is not limited to mental health, attention, learning, vision, and physical or health-related conditions). A student seeking academic accommodations should first register with Student Disability Services and then meet with the course instructor privately in the instructor’s office to make particular arrangements. Reasonable accommodations are established through an interactive process between the student, instructor, and SDS. See http://sds.studentlife.uiowa.edu/ for information.

Nondiscrimination in the Classroom

The University of Iowa is committed to making the classroom a respectful and inclusive space for all people irrespective of their gender, sexual, racial, religious or other identities. Toward this goal, students are invited to optionally share their preferred names and pronouns with their instructors and classmates. The University of Iowa prohibits discrimination and harassment against individuals on the basis of race, class, gender, sexual orientation, national origin, and other identity categories set forth in the University’s Human Rights policy. For more information, contact the Office of Equal Opportunity and Diversity, diversity@iowa.edu or visit diversity.uiowa.edu.

Academic Honesty

All CLAS students or students taking classes offered by CLAS have, in essence, agreed to the College’s [Code of Academic Honesty] “I pledge to do my own academic work and to excel to the best of my abilities, upholding the IOWA Challenge I promise not to lie about my academic work.
to cheat, or to steal the words or ideas of others; nor will I help fellow students to violate the Code of Academic Honesty.” Any student committing academic misconduct is reported to the College and placed on disciplinary probation or may be suspended or expelled (CLAS Academic Policies Handbook).

**CLAS Final Examination Policies**

The final examination schedule for each class is announced by the Registrar generally by the fifth week of classes. Final exams are offered only during the official final examination period. No exams of any kind are allowed during the last week of classes. All students should plan on being at the UI through the final examination period. Once the Registrar has announced the date, time, and location of each final exam, the complete schedule will be published on the Registrar’s website and will be shared with instructors and students. It is the student’s responsibility to know the date, time, and place of a final exam.

**Making a Suggestion or a Complaint**

Students with a suggestion or complaint should first visit with the instructor (and the course supervisor), and then with the departmental DEO. Complaints must be made within six months of the incident (CLAS Academic Policies Handbook).

**Understanding Sexual Harassment**

Sexual harassment subverts the mission of the University and threatens the well-being of students, faculty, and staff. All members of the UI community have a responsibility to uphold this mission and to contribute to a safe environment that enhances learning. Incidents of sexual harassment should be reported immediately. See the UI Office of the Sexual Misconduct Response Coordinator for assistance, definitions, and the full University policy.

**Reacting Safely to Severe Weather**

In severe weather, class members should seek appropriate shelter immediately, leaving the classroom if necessary. The class will continue if possible when the event is over. For more information on Hawk Alert and the siren warning system, visit the Department of Public Safety website.
Guidelines for Approval of VEE Courses and Educational Experiences

The following guidelines for the three Validation by Educational Experience (VEE) requirements are used by the VEE Administration Committee to determine whether or not specific courses or educational experiences are appropriate to fulfill the VEE requirements. The “Application for Approval of Course/Experience for Validation by Educational Experience Credit” must be submitted to the VEE Administration Committee along with the required documentation. If a course/educational experience is approved, it will be added to the “Directory of Approved VEE Courses/Experiences” or the “Standardized Exams and Other Educational Experiences” list on the CAS (www.casact.org) and SOA (www.soa.org) Web Sites.

VEE–Applied Statistical Methods

Courses that meet this requirement may be taught in the mathematics, statistics, or economics department, or in the business school. In economics departments, this course may be called Econometrics. The material could be covered in one course or two. The mathematical sophistication of these courses will vary widely and all levels are intended to be acceptable. Some analysis of real data should be included. All of the topics listed below should be covered:

Regression analysis
- Least square estimates of parameters
- Single linear regression
- Multiple linear regression
- Hypothesis testing and confidence intervals in linear regression models
- Testing of models, data analysis and appropriateness of models

Time series/forecasting
- Linear time series models
- Moving average, regression-based and/or ARIMA models
- Estimation, data analysis and forecasting with time series models
- Forecast errors and confidence intervals

VEE–Corporate Finance

The typical corporate finance program covers the topics below in two semesters with an introductory course followed by a more advanced semester. If the second course covers most of the topics, then only the second course will be required. Where the topics are split across two semesters or courses, both will be required. The exceptional case where the corporate finance topics are covered in only one course, with no finance prerequisite, will also be considered, however, this will typically be at a more advanced level than a course designed for general business students. Most of the topics listed below should be covered:

- Definitions of key finance terms: stock company; capital structure
- Key finance concepts: financing companies; characteristics and uses of financial instruments; sources of capital; cost of capital; dividend policy; personal and corporate taxation