University of Guelph
College of Physical and Engineering Science
Department of Mathematics and Statistics

# STAT*3240 Applied Regression Analysis

Course Outline
Fall 2016

INSTRUCTOR: Jeremy Balka x54481 OFFICE: 550 MacN EMAIL: jbalka@uoguelph.ca

OFFICE HOURS: 2:30 – 3:20 Monday, Tuesday, Thursday in 550 MacN.

LECTURES: 1:00–2:20 Tuesday and Thursday in ROZH 108.
(Note that Tuesday October 11 is Fall Study Break Day. There are no classes scheduled at the U of G that day. Lectures that would normally fall on this day are rescheduled to Thursday December 1.)

LABS: 3:30–4:20 Thursday in SSC 1305 (The first lab will be on Thursday September 15.)

PREREQUISITES:
(1 of IPS*1510, MATH*1210, MATH*2080), (1 of MATH*1160, MATH*2150, MATH*2160), STAT*2050

CREDIT WEIGHT: 0.5 credits.

CALENDAR DESCRIPTION: This course reviews simple linear regression and introduces multiple regression with emphasis on theory of least squares estimation, residual analysis, and model interpretation. Within the multiple regression context, transformations of variables, interactions, model selection techniques, ANOVA, influence diagnostics and multicollinearity will be discussed. Topics may also include Box-Cox transformations, weighted regression, and logistic and Poisson regression. This course is supplemented with computer labs involving interactive data analysis using statistical software.

COURSE OBJECTIVES: Upon successful completion of the course, students will be able to:

- Select, implement and interpret appropriate regression models to explain real-world phenomena.
- Demonstrate an understanding of the limitations and uncertainties associated with regression models.
- State the assumptions of regression models, and investigate these assumptions using appropriate plots and statistics.
- Demonstrate a command of the mathematical foundations of regression models.
- Demonstrate competence in using statistical software to implement regression procedures.
- Effectively communicate a proper interpretation of the results of a regression analysis.

(OPTIONAL) RECOMMENDED TEXT: *Introduction to Linear Regression Analysis* by Montgomery, Peck, and Vining. 5th edition. Wiley, 2012. (A copy of this textbook will be available on reserve at the library.)

TENTATIVE LECTURE SCHEDULE:

The following is a rough outline of the lecture schedule. We will likely cover all of the following topics, but the ordering of topics and timeline will change.

Week 1–Week 3: Simple Linear Regression. (The simple linear regression model, least squares, properties of the least squares estimators, model assumptions, interpretation of model parameters, inference on the slope and intercept, prediction, maximum likelihood estimation, the coefficient of determination, ANOVA for regression.)

Week 3–Week 5: Introduction to Multiple Linear Regression. (The multiple linear regression model, matrix notation, properties of the least squares estimators, inference on model parameters, estimation and prediction, interpretation of output, standardized regression coefficients, multicollinearity.)

Week 6: Model Assumptions and Checking Model Adequacy. (Residual analysis, standardized and studentized residuals, residual plots, partial regression and partial residual plots, outliers, lack of fit tests.)

Week 7: Polynomial Regression Models, Indicator Variables. (Including higher order terms in the linear regression model, the use of indicator variables to represent categorical explanatory variables, one-way ANOVA as a regression.)

Week 8: Transformations and Weighting. (Variance stabilizing transformations, intrinsically linear models, the Box-Cox transformation, weighted least squares.)

Week 9: Leverage and Influence. (Leverage, influence, measures of leverage and influence, treatment of influential observations.)

Week 10: Model Building. (Model building techniques, forward selection, backward selection, stepwise selection, Mallow's Cp.)

Week 11: Nonlinear Regression. (A brief introduction to nonlinear regression models.)

Week 12: Generalized Linear Models. (Brief introduction to generalized linear models, logistic regression, interpretation of parameters, Poisson regression.)

GRADING SCHEME:

- 25% Assignments. There will be 5 assignments, but only your best 4 will count towards your final grade.
- 30% Midterm exam. 11:30–12:50 Thursday October 23. Location TBA.
- 45% Final exam. 2:30–4:30 December 4. Location TBA.

Each student's final grade will be calculated using this grading scheme. The passing grade for this course is 50% (students who have a calculated final grade that is less than 50% will fail the course).

IMPORTANT DATES:

| Date | Assessment |
|---|---|
| Friday September 23 | Assignment #1 is due (The deadline is 2:00 pm) |
| Friday October 7 | Assignment #2 is due (The deadline is 2:00 pm) |
| Friday October 21 | Assignment #3 is due (The deadline is 2:00 pm) |
| Thursday October 27 (1:00–2:20) | Midterm examination |
| Friday November 18 | Assignment #4 is due (The deadline is 2:00 pm) |
| Friday December 2 | Assignment #5 is due (The deadline is 2:00 pm) |
| Tuesday December 13 (2:30 - 4:30) | Final Exam |

ASSIGNMENT AND EXAM POLICIES:

- **Any assignment not submitted by the deadline will not be marked and will receive a grade of 0.**
- While you are encouraged discuss approaches to assignment questions with other students, your submitted assignment must be your own work. Copying any part of another student's work is considered academic misconduct. (Please read the section on academic misconduct at the end of this document and in the undergraduate calendar.)
- In calculating your overall mark, I will throw out your worst assignment grade. This is not done to be nice, but to account for possible illnesses, computer problems, car accidents, house fires, etc. If you have extremely serious issues that cause you to miss more than one assignment, see me in person.
- For the midterm examination, you may bring in one $8.5 \times 11$ (letter size) piece of paper, with whatever you would like written on both sides. For the final examination you may bring in two sheets of this size.

POLICY FOR A MISSED MIDTERM EXAM: If you miss the midterm exam due to medical illness or another valid (and documented) reason, your final exam will be reweighted to make up for the missed exam.

COMPUTING LABS: The computing labs are held in SSC 1305. In these labs you will have an opportunity to work on your assignments, which will require the use of SAS and/or R.

COURSE WEBSITE: courselink.uoguelph.ca. Notes, announcements, assignments, etc. will be posted here.

## UNIVERSITY POLICIES

EVALUATING THE COURSE AND PROFESSOR: During the final two weeks of the semester, students will have an opportunity to evaluate the course and instructor.

ACADEMIC MISCONDUCT: The University of Guelph is committed to upholding the highest standards of academic integrity and it is the responsibility of all members of the University community – faculty, staff, and students – to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff and students have the responsibility of supporting an environment that discourages misconduct. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

The Academic Misconduct Policy is detailed in the Undergraduate Calendar:
http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml

EMAIL COMMUNICATION: As per university regulations, all students are required to check their <uoguelph.ca> email account regularly: email is the official route of communication between the University and its students.

WHEN YOU CANNOT MEET A COURSE REQUIREMENT:
When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons, please advise the course instructor (or designated person, such as a teaching assistant) in writing, with

your name, id#, and e-mail contact. See the undergraduate calendar for information on regulations and procedures for Academic Consideration:
http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml

DROP DATE: The last date to drop one-semester courses, without academic penalty, is Friday November 4. For regulations and procedures for Dropping Courses, see the Undergraduate Calendar:
http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml

ACCESSIBILITY: The University of Guelph is committed to creating a barrier-free environment. Providing services for students is a shared responsibility among students, faculty and administrators. This relationship is based on respect of individual rights, the dignity of the individual and the University community's shared commitment to an open and supportive learning environment. Students requiring service or accommodation, whether due to an identified, ongoing disability or a short-term disability should contact Student Accessibility Services as soon as possible.
For more information, contact SAS at 519-824-4120 ext. 56208 or email csd@uoguelph.ca or see the website:
http://www.uoguelph.ca/csd/

RESOURCES: The Academic Calendars are the source of information about the University of Guelph's procedures, policies and regulations which apply to undergraduate, graduate and diploma programs:
http://www.uoguelph.ca/registrar/calendars/index.cfm?index

ELECTRONIC RECORDING: The electronic recording of classes is expressly forbidden without the prior consent of the instructor. This prohibition extends to all components of the course, including, but not limited to, lectures, seminars, and lab instruction, whether conducted by the instructor or a seminar leader or demonstrator, or other designated person. When recordings are permitted they are solely for the use of the authorized student and may not be reproduced, or transmitted to others, without the express written consent of the instructor.