## Syllabus: M349R (Unique 54105) Spring 2018

## Applied Regression and Time Series

**Introduction and Course Objectives**

The purpose of this course is to provide students in statistics and applied disciplines with an introduction to simple and multiple regression methods for analyzing relationships among several variables, and to elementary time series analysis. The emphasis will be on fitting suitable models to data, evaluating models using numerical and graphical techniques and interpreting the results in the context of the original problem, as opposed to derivation of mathematical properties of the models. At the end of this course students will be able to analyze many kinds of data in which one variable of interest is thought to depend on, or at least be related to, several other measured quantities, and some kinds of data collected over time or in some other serial manner.

Topics include: least squares estimation; inference for regression coefficients and prediction, residual analysis, multicollinearity, autocorrelation, heteroskedasticity, anova and ancova, logistic regression, delta method, time series regression, decomposition methods, exponential smoothing, arima models (Box-Jenkins Methodology), model identification, model diagnostics and validation, forecasting.

**Instructor:** Gustavo Cepparo **Office: RLM 13.148 Phone: 232-6189**

**E-mail:** gcepparo@math.utexas.edu

**Lectures:**

MWF at 11:00 - 12:00 RLM 7.124

**Office hours:**

M 7:30 -8:50, W 10:00-10:35, F 1:00- 1:35 and by appointment

**ADVICE FOR SUCCESS**   
Actively participate in the course by attending lectures, asking questions, doing the assigned homework problems and additional problems covering your weak topics, and utilizing my office hours. Please do come to my office hours if you have questions or concerns.   
  
**Before you email me to ask a question about the rules and procedures of this course, please read through this syllabus to see if the answer is written here. I diligently tried to include here any information that you might ask; please utilize it.**

**Textbook:**

Forecasting, Time Series, and Regression, by Bowerman (Duxbury, 2005).

**Prerequisites:**

A semester of statistics such as Applied Statistics (M358K) or Mathematical Statistics (M378K) and Probability Models with Actuarial Applications (339J) or Actuarial Contingent Payments I (339U).

**Attendance Policy**:  
You are expected to attend all lecture sessions. If you are absent, *do not email or otherwise contact me to ask what material we covered during class, what the assignments are, what sections the exams will cover, or any other questions that I have answered or will answer during class*. In such a situation, you should contact a classmate to get notes and information for the class you missed. It is certainly a good idea to work together throughout the semester.

**Honor Code**:

The class is expected to uphold [The University of Texas at Austin Honor Code](http://registrar.utexas.edu/catalogs/gi09-10/ch01/index.html). The core values of the University of Texas at Austin are learning, discovery, freedom, leadership, individual opportunity, and responsibility. Each member of the University is expected to uphold these values through integrity, honesty, trust, fairness, and respect toward peers and community

**Project Assignments:**

Project assignments will be assigned regularly (approx. every two weeks). There will be quite a lot of homework, and most of it involves computer work with interpretations and writing conclusions. I will not grade any disorganized or difficult-to-read assignments. Your homework is your best piece of work. I will not accept homework in loose sheets of paper. Each student should type and submit their own solutions to project assignment problems. Copying another student's solution or that from another text is a violation of the honor code and fails to contribute to your personal statistical education development. Students must show ALL work to each solution.

***No late assignments will be accepted for any reason! No credit will be given for unsupported answers. This means that all work should be shown, neatly and logically, using correct notation.***

***Format***: *Must be stapled and no ripped pages from a notebook will be accepted. Write*

*your name at the top of each page. The first page should state the class, section number,*

*instructor’s name, and book sections included in the assignment. Label each*

*question clearly, specifying the section and exercise number (i.e. 4.1 #32). Should be*

*organized, clean, and easy to read.*

**Grading**: 5 Semester Projects 8% each

Final Project 12% and 3 Tests 16% each.

**Quantitative Reasoning:**  This course carries the Quantitative Reasoning flag. Quantitative Reasoning courses are designed to equip you with skills that are necessary for understanding the types of quantitative arguments you will regularly encounter in your adult and professional life. You should therefore expect a substantial portion of your grade to come from your use of quantitative skills to analyze real-world problems.

**Grading**.  Plus/minus grades will be assigned for the final grade as follows: A (100-92.6), A- (92.5-89.6), B+ (89.5-86.6), B (86.5-82.6), B- (82.5-79.6), C+ (79.5-76.6), C (76.5-72.6), C- (72.5-69.6), D+ (69.5-66.6), D (66.5-62.6), D- (62.5-59.6), F (59.5-0).

(N.B) I will not bump.

Grades will be recorded in Canvas. ***Canvas is NOT used to determine your semester grade in this course.*** Canvas is only used as a means to store and share your grades. All of your individual grades will remain in Canvas as the score you originally earned on each of them. ***Your semester grade for the course is determined as detailed in this syllabus.*** Any discussion on homework grades must occur prior the final exam. Your final exam grade is final and non-negotiable. Thus, any discussions of your course grade must occur prior to the final exam administration.

Calendar (Lecture by lecture) M349R

“*Please note:  schedule changes may occur during the semester. Any changes will be announced in class.*”

Week 1

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| Wed. Jan. 17 | The Univariate Model (as a base model) and Randomization (Two sample and Matched Pairs Test) using R. |
| Fri. Jan. 19 | One sample t and Checking conditions with Bootstrap distributions in R. |

Week 2

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| Mon. Jan. 22 | Review of Sampling Distribution as a foundation for Inference. |
| Wed. Jan. 24 | The Bivariate Model vs Univariate Model. Simple Regression. The Least Squares estimator. |
| Fri. Jan. 26 | Root Mean Square Error and Adequate Predictor. |

Week 3

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| Mon. Jan. 29 | Inference on Regression. Residual Plots and Coefficient of Determination. |
| Wed. Jan. 31 | Calculating Standard Errors for Confidence Intervals and Prediction Intervals. Simpson’s Paradox. |
| Fri. Feb. 2 | Simpson’s Paradox in several two way tables and Regression. |

Week 4

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| Mon. Feb. 5 | Total Regression and Partial Regression (Correlation and Partial Correlation).  Multiple Regression and Interpreting Coefficients. |
| Wed. Feb. 7 | Residual Plots (again) in the context of Multiple Regression |
| Fri. Feb. 9 | Overall F-test and Individual t-tests. Dummy Variables |

Week 5

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| Mon. Feb. 12 | Continue with Dummy Variable notation. One-way Anova from Regression and Traditional Approach. |
| Wed. Feb. 14 | Interaction, Partial F-test. |
| Fri. Feb. 16 | More Practice with Dummy Variables and Variance Covariance Matrix and Ancova.  **(Test 1)** |

Week 6

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| Mon. Feb. 19 | Continue with Ancova. |
| Wed. Feb. 21 | Collinearity. |
| Fri. Feb. 23 | Continue with Collinearity. |

Week 7

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| Mon. Feb. 26 | Residual Analysis (Hat-values, DfFits, DfBetas, Studentized Residuals). |
| Wed. Feb. 28 | Continue with Residual Analysis (Using more SAS). |
| Fri. Mar. 2 | Continue with Residual Analysis. |

Week 8

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| Mon. Mar. 5 | Heteroskedasticity. |
| Wed. Mar. 7 | Continue with Heteroskedasticity (Using more SAS). |
| Fri. Mar. 9 | Continue with Heteroskedasticity. |

Week 9

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| Mon. Mar. 19 | Autocorrelation in Regression and in Time series Regression. Dummy variables for Seasonal Models in Time Series Regression with AR(1) errors structure. |
| Wed. Mar. 21 | An example of a Random Walk. The intercept model in TS Regression. |
| Fri. Mar. 23 | Moving Average and Random Walk (Calculate: Expectation, Variance, Covariance and Correlation for MA(1), MA(2) and AR(1)) |

Week 10

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| Mon. Mar. 26 | MA(1) and AR(1) (Using only SAS). |
| Wed. Mar. 28 | Correlograms (ACF and PACF). |
| Fri. Mar. 30 | Estimation MLE and Method of Moments (MoM).  **(Test 2)** |

Week 11

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| Mon. Apr. 2 | Four steps of Arima Modeling (Backshift Notation) (Using SAS) |
| Wed. Apr. 4 | Four steps of Arima Modeling (Model Comparison) |
| Fri. Apr. 6 | Intro to Seasonal Models (Box Jenkins Models) |

Week 12

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| Mon. Apr. 9 | Continue with Seasonal (Muttiplicative Backshift Notation) |
| Wed. Apr. 11 | Continue with Seasonal |
| Fri. Apr. 13 | Review Seasonal and Nonseasonal |

Week 13

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| Mon. Apr. 16 | Two out of three Optional Topics (below): Intervention Models and Building a Transfer Function Model (if time permits). |
| Wed. Apr. 18 | Intervention Models and Building a Transfer Function Model (with SAS) |
| Fri. Apr. 20 | Intervention Models and Building a Transfer Function Model |

Week 14

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| Mon. Apr. 23 | Linear Probability Model and Logistic Regression Model |
| Wed. Apr. 25 | Logistic Regression |
| Fri. Apr. 27 | Poisson Regression (if time permits) |

Week 15

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| Mon. Apr. 30 | Delta Method for one and two parameters (Confidence Intervals and Hypothesis Testing) (if time permits) |
| Wed. May 2 | A day for in class Test (during the semester)  The approximate day for Test 1 is Feb. 17 |
| Fri. May 4 | A day for in class Test (during the semester)  The approximate day for Test 2 is Mar. 31 |

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| Final Exam TBA (see UTdirect) | Test 3 during final’s week. The Final Project is due before our 3 hour Final Exam. Test 3 will have two parts: Part 1 (by hand) and Part 2 (with laptop) |

**Computer Work.** In this class we will be using SAS, R. I will distribute some material that will help you get started with SAS and R. Data will be imported to SAS from Excel. Data will be imported to R from notepad.

**SERVICES AVAILABLE TO STUDENTS**   
The University of Texas provides appropriate academic accommodations for qualified students with disabilities. Students with disabilities may request appropriate academic accommodations from the [Division of Diversity and Community Engagement, Services for Students with Disabilities](http://www.utexas.edu/diversity/ddce/ssd/), 471-6259. http://www.utexas.edu/diversity/ddce/ssd/  
  
Utilize the [Sanger Learning and Life Center](http://lifelearning.utexas.edu/)!   
  
[Counseling and Mental Health Center](http://www.cmhc.utexas.edu/), Student Services Bldg (SSB), 5th Floor, Hours: M-F 8am-5pm, 512-471-3515

**COMPUTER LAB**The mathematics department's 40 seats undergrad computer lab, RLM 7.122, is open to all students enrolled in math courses. Students can sign up for an individual account themselves in the computer lab using their UT EID.  
RLM Building Hours are:                  
M-Th:  6:00am -- 11:00pm                     
F:  6:00am -- 10:00pm                   
Sat:  6:00am -- 5:00pm                   
Sun:  2:00pm -- 11:00pm  
  
**STUDENT CONDUCT**

Cell phones and other hand-held devices must be put away out of sight and sound during class. You will be excused from class for the day if you are using your phone, tablet, etc. Please come to class on time. If you will be late or need to leave early for some legitimate reason, please tell me in advance. Coming and going during class is distracting to your fellow students and the instructor, and we do not like it.  
  
**PLANNED LECTURE and EXAM SCHEDULE:**       
Deviations from this tentative calendar may occur during the semester. The actual material covered each day can only be determined by attending the lectures.   
  
**RELIGIOUS HOLIDAYS**   
By UT Austin policy, you must notify me of your pending absence at least fourteen days prior to the date of observance of a religious holy day. If you must miss a class, an examination, a work assignment, or a project in order to observe a religious holy day, you will be given an opportunity to complete the missed work within a reasonable time after the absence.   
  
**DEADLINES FOR DROPPING A COURSE**   
If you drop a class on or before the 12th class day, the class will not show up on your transcript. If you drop a class after that date, the course will show up on the transcript with a "Q" grade.

**EMERGENCY EVACUATION POLICY**   
Occupants of buildings on The University of Texas at Austin campus are required to evacuate buildings when a fire alarm is activated. Alarm activation or announcement requires exiting and assembling outside. Familiarize yourself with all exit doors of each classroom and building you may occupy. Remember that the nearest exit door may not be the one you used when entering the building. Students requiring assistance in evacuation shall inform their instructor in writing during the first week of class. In the event of an evacuation, follow the instruction of faculty or class instructors. Do not re-enter a building unless given instructions by the following: Austin Fire Department, The University of Texas at Austin Police Department, or Fire Prevention Services office.  
  
**Behavior Concerns Advice Line**  
BCAL: 512-232-5050   
Link to information regarding emergency evacuation routes and emergency procedures can be found at: [www.utexas.edu/emergency](http://www.utexas.edu/emergency)