Purpose of Course: This course is a follow-up to the introductory econometrics course ECO 5350. (Eco 5350 is a prerequisite for this course or you may be allowed to take this class by instructor permission if you have had substantial training in statistics including regression analysis.) The major purpose of this course is to extend the student's econometric toolkit to regression models that have qualitative, limited, count or duration dependent variables. We will also study spatial linear regression models, and, time permitting, Panel Data Methods. Many of the examples used in the course will be taken from the fields of micro-econometrics and marketing research.

The student will learn the essentials of and demonstrate proficiency in

- The Maximum Likelihood Method including numerical optimization techniques and methods of statistical inference (Wald, Score, and Likelihood Ratio tests)
- Quasi (Robust) Maximum Likelihood Estimation and Inference
- Logit/Probit models, Unordered and Ordered Multinomial Logit/Probit Models, Truncated and Censored Regression Models, Duration Models, and Count Models
- Spatial Econometrics
- Proficiency in using the STATA computer software package
- Time Permitting, Static Panel Data Models including Fixed and Random Effects Models along with the Hausman Specification test

Textbook for Course: Analysis of Microdata (2nd ed.) by Rainer Winkelmann and Stefan Boes (Springer, 2009). Data sets used in this textbook can be found at www.sts.uzh.ch under the tab labeled “data” both in ASCII and Stata format. For students who in addition want to replicate some of the work we do in STATA using R, you might purchase the Supplementary textbook Applied Econometrics with R by Christian Kleiber and Achim Zeileis (Springer, 2008). The primary R package used in the Kleiber and Zeileis book is called AER. It contains R code and data sets used in their book. Also if you are interested in the application of R to specifically categorical data analysis you might want to consult the book Analysis of Categorical Data with R by Chris Bilder and Thomas Longhin, CRC Press, 2014. Their website www.chrisbilder.com/categorical contains R programs involving the analysis of the categorical data discussed in their book.
Computer Usage: We will primarily be using the STATA software package in this course. It can be found on SMU’s Apps.smu link that provides virtual access to STATA and other software program including SAS and SPSS. To use STATA on the Apps.smu system you will first need to download the Citrix Receiver. You can go to the website http://www.smu.edu/BusinessFinance/OIT/Services/AppsSMU and then, being a first time user, you will be prompted to download Citrix Receiver to your PC or laptop. Citrix Receiver provides you with “virtual” access to the STATA software in that Citrix makes it appear that you have STATA installed on your own computer when, in fact, it is being accessed from an SMU server on campus. After you install the Citrix Receiver on your computer, you can then logon to the Citrix Receiver by entering your student ID and personal password. Thereafter you can work on your homework assignments, etc.

The R package is what is called “freeware” or “shareware.” To download R to your PC or laptop, go to the website http://CRAN.R-project.org/ and download the “base” R package. For an introduction to the R language see chapters 1 and 2 of the Kleiber/Zeileis book or download introductory discussions of R contained on the above R website.

Evaluation of Student:

The evaluation of the student consists of four parts:

- Quick Quizzes (20%)
- Exercises (30%)
- Two Mid-term Exams (25% each)
- A Final Exercise to be handed in by the time of the scheduled final exam for this course as part of the above 30% credit for Exercises. The Final Exercise will carry twice the number of points of a “regular” exercise that is assigned during the semester.

Additional Information on QQs and Homework Exercises:

The Quick Quizzes (QQs) will consist of a short answer and/or multiple-choice quiz that will be administered in the first five minutes of the class. The QQs are designed to see if you have retained the information of the previous lecture and if you have done any assigned readings that I may have asked you to do. In addition to keeping the students current in the class and providing review material for the mid-term exams, the QQs allow me to keep track of student attendance which I consider when writing recommendation letters for students. It is my policy to drop your lowest QQ score before calculating your QQ average.

With respect to homework exercises, students can confer with each other with respect to programming advice and discussion of basic ideas but in the final analysis each student is expected to write up his/her own homework answers and not make copies of others’ homework. Copying someone else’s homework to hand in as one’s own work is a violation of the SMU Honor Code and will be dealt with according to the rules of the SMU Honor Code. It is important to know that the homework assignments are very important in that the basic ideas covered by them invariably show up on mid-term exams. If you know you are going to be missing a class on the day a homework exercise is due, hand in your homework in advance to receive full credit for your work. Any homework that is handed in late will be given a one letter
grade reduction for each day of tardiness. It is my policy to drop your lowest exercise score before calculating your exercise average.

If you must miss a class due to legitimate circumstances beyond your control, be sure and contact me beforehand so that I will know of your circumstances. If excused, I will correspondingly excuse you from any QQ that is given that day. I want to emphasize that diligent attendance in this course is essential because a lot of the course material presented in class will be from my personal class notes and can’t be found in any textbook per se. **Note:** After 4 unexcused class absences, I reserve the right to administratively drop students from the class.

**My grading scale in this course is as follows:**

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<tr>
<th>Percentage</th>
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<tr>
<td>92-100</td>
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<td>90-91</td>
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<td>0-59</td>
<td>F</td>
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</tbody>
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Classroom Website: [http://faculty.smu.edu/tfomby/](http://faculty.smu.edu/tfomby/)

**Office:** Room 301M, Umphrey Lee, 214-768-2559. E-mail address: tfomby@smu.edu.

**Office Hours:** 3:00-4:30 PM MW or by appointment.

**My Graduate Teaching Assistant:** Igor Zhadan. His E-mail address is: izhadan@smu.edu. If you should need extra tutorials or help outside of my office hours, contact Mr. Zhadan and he will be happy to go over concepts that you may not fully understand.

**Important Dates to Remember:**

- **First Day of Class:** Wednesday, January 20
- **MLK Day:** Monday, January 18 (No Class)
- **Spring Break:** Monday – Sunday, March 7 – 13 (No Classes)
- **Last Day to Drop a Course:** Wednesday, April 6
- **Last Day of Semester in this Class:** Monday, May 2

**Exam Dates:**
- **First Midterm – Monday, March 14.** This is the first day of classes following Spring Break, March 7 – 13. Exam will cover the topics covered in class up until Wednesday, March 2.
Second Midterm – Monday, April 25. Exam will cover the topics covered in class since the first mid-term exam.  

Final Exam Date: In lieu of an in-class Final Exam, a final exercise should be handed in by the time of the scheduled final exam in this class – Saturday, May 7, 6:30 – 9:30 pm.

General comments on work and class etiquette:

In order to succeed in this class, constant work is essential. Come to class. Read all assigned readings, complete all exercises on time, and prepare for the Quick Quizzes. Don’t get behind. If there is something in class discussion or homework assignments that you don’t understand, don’t hesitate to ask me in class, after class, during office hours, or through e-mail.

Obviously, general rules of etiquette apply: cell phones are to be turned off during class and miscellaneous reading material stowed away.

Some Standard Stuff You Should Know

Excused Absences for University Extracurricular Activities:

Excused Absences for University Extracurricular Activities: Students participating in an officially sanctioned, scheduled University extracurricular activity should be given the opportunity to make up class assignments or other graded assignments missed as a result of their participation. It is the responsibility of the student to make arrangements with the instructor prior to any missed scheduled examination or other missed assignment for making up the work. (University Undergraduate Catalogue)

Disability Accommodations: Students needing academic accommodations for a disability must first register with Disability Accommodations & Success Strategies (DASS). Students can call 214-768-1470 or visit http://www.smu.edu/Provost/ALEC/DASS to begin the process. Once registered, students should then schedule an appointment with the professor as early in the semester as possible, present a DASS Accommodation Letter, and make appropriate arrangements. Please note that accommodations are not retroactive and require advance notice to implement.

Religious Observance:

Religious Observance: Religiously observant students wishing to be absent on holidays that require missing class should notify their professors in writing at the beginning of the semester, and should discuss with them, in advance, acceptable ways of making up any work missed because of the absence. (See University Policy No. 1.9.)
Honor Code:

All SMU students are bound by the Honor Code (see SMU Student Handbook for a complete discussion of the SMU Honor Code). The code states that “any giving or receiving of aid on academic work submitted for evaluation, without the express consent of the instructor, or the toleration of such action shall constitute a breach of the Honor Code.” A violation can result in an “F” for the course and an Honor Code Violation on your transcript.

TOPICS

I. Introduction to STATA Software
   A. Apps.smu and how to use it
   B. A run through with a sample STATA program

Reference: Class presentation

II. What are Microdata?
   A. Types of Microdata
   B. Common Elements of Microdata Models
   C. Examples

Reference: Chapter 1 in Winkelmann and Boes

III. Maximum Likelihood Estimation - I
   A. Introduction
   B. Definition of Likelihood Function
   C. Example 1: The Bernoulli Distribution
   D. Example 2: The Normal Distribution
   E. Example 3: The Classical Normal Linear Regression Model

Reference: Chapter 3 in Winkelmann and Boes

IV. Maximum Likelihood Estimation - II
   A. Score Function
   B. Hessian Matrix
   C. Information Matrix
   C. Properties of ML Estimators
      i. Consistency
      ii. Asymptotic Normality
      iii. Asymptotic Efficiency
   D. Covariance Matrix of ML Estimators

Reference: Chapter 3 in Winkelmann and Boes
V. Maximum Likelihood Estimation – III
   A. Numerical Optimization Methods
   B. Analytic Solution – Example: Least Squares in Classical Normal Linear Regression Model
   C. Non-analytic Solution – Example: Logistic Model
      i. Newton-Raphson method
      ii. Other methods
      iii. Global Concavity – guaranteed convergence

Reference: Chapter 3 in Winkelmann and Boes

VI. Maximum Likelihood Estimation – IV
   A. Asymptotically Equivalent Testing Methods
   B. Wald Test
   C. Likelihood Ratio Test
   D. Score (Lagrangian Multiplier) Test

Reference: Chapter 3 in Winkelmann and Boes

VII. Maximum Likelihood Estimation – V
   A. Quasi (Robust) Inference in Maximum Likelihood Estimation
   B. Mean Function assumed to be correctly specified
   C. Sandwich Variance-Covariance Matrix
   D. Example: White’s Standard Errors

Reference: Classroom Presentation

VI. Binary Logit Model
   A. Likelihood Function
   B. Variance-Covariance Matrix
   C. Interpretation of Coefficients – Marginal Effects and Log Odds Ratios
   D. Model Selection
   E. Contingency Tables and ROC curves
   F. Applications/Target Marketing and Bond Ratings
   G. Comparison to Probit Model

Reference: Chapter 4 in Winkelmann and Boes

VI. Unordered Multinomial Response Models
   A. Multinomial Logit Model
   B. Conditional Logit Model
   C. Multinomial Probit Model
   D. Model Selection
   E. Applications in Textbook

Reference: Chapter 5 in Winkelmann and Boes
VII. Ordered Multinomial Response Models
   A. Ordered Probit Model
   B. Ordered Logit Model
   C. Sequential Models
   D. Model Selection
   E. Applications in Textbook

Reference: Chapter 6 in Winkelmann and Boes

VIII. Limited Dependent Variable Models
   A. Truncation versus Censoring
   B. Truncated Regression (Tobit) Model
   C. Censored Regression Model
   D. Heckman Selection Model
   E. Model Selection
   F. Applications in Textbook

Reference: Chapter 7 in Winkelmann and Boes

IX. Duration (Survival) Dependent Variable Models
   A. Definition of Density, Survival, and Hazard Functions
   B. Exponential, Weibull, Loglogistic, and Lognormal density functions and their corresponding Survival and Hazard functions
   C. Cox Proportional Hazard Model
   D. Nonparametric Methods
   E. Model Selection
   F. Applications in Textbook

Reference: Chapter 8 in Winkelmann and Boes

X. Count Models
   A. Poisson Model and the equi-dispersion assumption
   B. Negative Binomial Model
   C. Zero Inflated Models
   D. Model Selection
   E. Applications in Textbook

Reference: Chapter 8 in Winkelmann and Boes

XI. Spatial Linear Regression Models
   A. Distance Measures
   B. Spatial Error Model
   C. Spatial Lag Model
   D. Model Selection
   E. Application: Boston Housing Data

Reference: Classroom Presentation
TIME PERMITTING:

XII. Static Panel Data Models
   A. Two Period Panel Models – Difference in Difference Approach
   B. Fixed Effects Models
   C. Random Effects Models
   D. The Hausman Test
   E. Model Selection
   F. Application: Rental prices in college towns


END OF COURSE