

**SOCIOLOGY 6707**  
**INTERMEDIATE DATA ANALYSIS**

Winter 2020

**Blair Wheaton**

Department of Sociology

Time: Tuesday 1-3:30, tutorial Fridays 1-2

Place: Room 240, Dept. of Sociology, 725 Spadina Avenue

TAs: Patricia Louie ([patricia.louie@mail.utoronto.ca](mailto:patricia.louie@mail.utoronto.ca))

### **Overview**

This course functions as a follow-up to a first graduate level statistics course. The obvious goal is to develop the student's skills as both a producer and a consumer of quantitative findings and data, but the less obvious, but equally important, goal is to develop an understanding of the fit between ideas and models, i.e., how ideas are expressed in models.

The course is intended not just for the specialized student, but for a range of students with different needs, such as:

- increased reading breadth in areas of interest, or in key areas of the discipline or the social sciences in general.
- development of data analytic skills and awareness of available choices in data analysis situations.
- comprehension and application of specific techniques to be used in ongoing and future personal research, dissertation research, and research grants.
- learning a language and a thinking framework that gives access to a wider range of the discipline and the social sciences and thus facilitates the generalization of future audiences in one's own research..

### **Themes**

- *The matching of ideas to their representation in models.* A common problem in many areas of research is the lack of fit between the ideas stated in a theory and the way the theory is tested. We emphasize the issue of fit and representation of ideas, as "embodied" in the techniques included in the course.
- *Practice in data analysis techniques.* The course has been designed and run for a number of years with using exercises on the computer, primarily using SAS but also other programs. These exercises each involve data analysis problems that the student articulates. My role in this part of the course is to be available to students to help with execution of computer problems, and to discuss problems in analyzing and interpreting data. I generally encourage students to help each other with the analytic phases of each project.

- *Choosing the appropriate technique given the analytical situation and type of data.* As the course progresses, an increasingly important issue will be choice of technique, as a function of: type of data, sample size, distributions of variables, nature of underlying concepts (continuous vs. categorical), preferred modes of interpretation, and the nature of the question.
- *Methods and theory closely linked.* Different techniques frame specific forms of theorizing that are not possible outside of those methodological frameworks.

## Topic Details

### *Part 1: Generalizing the Regression Model*

- Interactions and their Interpretation
- Nonlinear Regression (functional forms, splines)
- Logistic Regression (binomial, multinomial, ordinal)
- Regression for Nonnormal Variables (Poisson and Negative Binomial)

We will consider the nature and interpretation of interactions (multiplicative effects of variables), nonlinearity (both functional forms and spline regression), generalizations to categorical outcomes (logistic regression), including both dichotomous and multiple category outcomes, and regression for rare and highly skewed outcomes.

### *Part 2: Structural Equation Models*

- The Transition from Equations to Models
- Structural Equation Models: An Introduction
- Structural Equation Models: Testing and Fitting
- Cross-Group Structural Equation Models

We will include a section on structural equation models, including a section on the point of specifying models and process, and a section on the basics of structural equation modeling. We will also consider the testing and fitting of SEM models, and the comparison of models across groups.

### *Part 3: Hierarchical and Growth Curve Models.*

- Basic 2-level and 3-level HLM models
- Growth Curve Models
- The Generalized HLM Model (Poisson, Logistic).

These methods address the classic theoretical problem of effects across levels of social reality, specifically targeting the effects of social context on individuals. Social context refers to the effects of any shared context with collective membership. The concept is closely related to idea that layers of social reality can be seen as “nesting units” of increasing size and complexity. Thus, you can study the effects of schools on students, of neighbourhoods on families, of family structure on children, of community on individual opportunities, of social structure on individuals, etc. We will also consider hierarchical models for discrete outcomes. The growth curve model is a direct

extension of the general hierarchical linear model, used to track trajectories of change over lives as a function of time. This technique is especially useful for specifying sources of disparities or inequalities in developmental, social, or other life outcomes over time, with an emphasis on the timing in the life course of the appearance of disparities.

***Part 4: Combined Cross-Section/Time Series Analysis:  
Fixed and Random Effects Regression for Panel Data***

- Fixed and Random Effects Regression for Panel Data
- Fixed Effects Models for Other Techniques in the Course.

This section considers cross-section / time series models, with an emphasis on fixed-effects and random-effects models and what they do and do not accomplish. Fixed effects models are emphasized, primarily because they claim to take into account a broad class of unmeasured variables left out of the regression which may overlap with the effects of the independent variables in the equation. Fixed effects here stand for stable individual differences in all forms, e.g., biological givens, ascriptive social statuses, and family background. We conclude this section by applying the fixed effects model to techniques discussed earlier in the course, including structural equation models, logistic regression, and Poisson models.

***Part 5: Event History/ Survival Models***

- The Discrete-Time Event History Model.
- Grouped Continuous Time Models

The course will consider cases where event history models should be used rather than logistic regression, including the many situations where the timing of an event is as important as its occurrence. Often we study events (marriage, promotion, entry into the labour force, childbearing, etc.) which occur at different times for different people. The event history model takes into account both the occurrence of an event and its timing, while logistic regression can only study the occurrence of the event. We will only consider discrete-time models this year, but these models are very flexible.

## **Prerequisites**

The course assumes you know the basics of linear regression, including multiple regression. There will be a voluntary review class for basic regression held in the first week or two. Some of the tutorials on Fridays will provide examples of software used in the course. All of the necessary tools for programming are taught in tutorials, using template programs.

## **Required Work**

There is a mid-term test in class, discussed below. Beyond that, you will *either* do three assignments, coupled with a final exam where you will choose to do **one** of four questions, *or* you will do two assignments, coupled with a final exam where you will do three of four questions.

Both the TA and I are available throughout assignment work to answer questions about computer issues and the interpretation of assignment questions. *Both the second and third assignments involve choice of a specific technique from a list of three topics* (structural equation models, hierarchical models, and fixed effects panel regression). *What you choose will determine the timing of your due*

*dates*. The first assignment is standard for everyone with a fixed due date. This assignment considers generalizations of the regression model discussed in the first three weeks.

I expect students to work in groups, formed voluntarily and by mutual agreement among students. This is encouraged for three reasons: 1) to distribute the workload; 2) to encourage collective learning and communication of skills and knowledge among students; and 3) to avoid isolating students with specific computer problems. *All grades from these assignments are assigned equally to students within groups*. Groups *must* be from 2 to 3 in size.

There will be a final test on the last day of class. This test is short if you choose to do three assignments, and more involved if you choose to do two assignments. To be specific about how this works, there are three topics after the term test to choose from for assignments:

1. Structural Equation Models
2. Hierarchical Linear Models
3. Fixed Effects Panel Regression

We will discuss event history models as the final topic, but it will not be available for assignments. The final will have four questions to choose from, on these topics:

1. Structural Equation Models
2. Hierarchical Linear Models
3. Fixed Effects Panel Regression
4. Event History Models

Your choices involving assignments and the final test are as follows:

- If you do two assignments, you will write a final answering questions on the other three topics on the final, but not in the area of your assignment #2. As a result, you will not have choice about which questions to answer.
- If you do three assignments, you will be able to write a short final choosing one of the two topics you did not choose for assignments #2 and #3.

The first test is designed to provide a review of notes at a crucial point in the course. I have found in the past that students gain in their ability to understand material in the later phases of the course due to this review of material and consolidation of their knowledge in the middle of the course. All tests are “open-book”, i.e., my notes are allowed.

### **Weights for Required Work**

Work	Weight for 3 assignment option	Weights for 2 assignment option
1. Assignment #1	20%	25%
2. Term Test	25%	25%
3. Assignment #2	20%	25%
4. Assignment #3	20%	0%
5. Final Test (in class)	15%	25%

## Data Used for Assignments

This course is an overview of a series of techniques. *I require that everyone use the same class data for assignments.* This requirement is based on my experience with more flexible approaches I used in the past, which led to a number of problems. The most important computer issue in a course such as this is *not* running a procedure – it is manipulating the data. This *is* a course in data analysis. As a result, I make your coding part of the issue in grading assignments, because this is where so many of the problems in producing credible findings occur.

I require using class data for these reasons: 1) I need to understand myself the structure of the data, the nature of the sample, and whether variables exist that conform to what you want to do, so that I can give advice during assignments; 2) there are few data sets that can be used for *all* of the techniques in this course, and we do not want to change data sets across assignments (although it may be necessary for HLM); 3) in general, data has to be at least three-wave panel data, or sufficiently clustered to allow for hierarchical models.

This year we will use the NLSY79, the National Longitudinal Survey of Youth, 1979, and and/or the NLSY79 Children and Young Adults, for assignments, except for HLM. The NLSY79 is one of the most widely used data sets in the world: it is a continuing longitudinal study of youth 14-22 in 1979 in the United States. There were a total of 12, 686 individuals in the original sample. A sub-sample of individuals was followed every year until 1994, and then every two years after that, until 2014. The age of the sample at that time varied from 49 to 58 years old. You will be able to set up your own account on the NLSY website and download data directly. The NLSY79 Child/YA data set is a separate study of the children of the NLSY79 cohort. There are 11.521 children that have been followed since birth, with the range in ages covering 0 to 42 years old in 2014. Both data sets can be reviewed at the NLSY web site, including the design, topics, measures, and codebooks. You can download the data directly from this site.

We will also have access to specially extracted and anonymized data from the Toronto Study of Neighbourhoods and Well-Being (2011) for the HLM assignment. If you do this assignment, you must sign a release form promising not to use your results for public presentation in any form or for publication. In fact, you can apply for that approval after the course, if results look promising.

## Reading

There is *no* required reading beyond the set of notes I have developed specifically for this course. The material is intended to be a relatively friendly but rigorous discussion of each technique or type of analysis. The notes are sold on an individual basis, and will be available at Three Cent Copy across the street.

I also hand out a reference list for each topic in the course, printed in a separate document. This list will be uploaded to Quercus, or you can get a copy in class. Under each topic of the reference list, I will include both basic introductions and more complete overviews of each technique, as well as a list of substantive applications of the technique in journals.

## Class Schedule

The attached schedule shows the topics covered class-by-class, as well as due dates for all required work.

## Web Sites with Basic Mathematical and Statistical Help.

I also strongly encourage use of online sources for learning SAS. The UCLA site for SAS is one of the best and publicly accessible here:

<http://www.ats.ucla.edu/stat/sas/>

Or on You Tube, an introduction to SAS done by SAS itself:

[https://www.youtube.com/watch?v=r1Yy\\_sYbfy0](https://www.youtube.com/watch?v=r1Yy_sYbfy0)

Or the introductory online course run by Boston University:

<https://support.sas.com/edu/schedules.html?ctry=us&crs=PROG1#s1=1>

I will also upload to Blackboard free programming SAS guides you can also download online. These include the “famous” Little SAS Book, a general programming guide:

[http://www.dermepi.eu/wp-content/uploads/2017/04/Little.SAS\\_.Book\\_.A\\_Primer.Third\\_.Edition.pdf](http://www.dermepi.eu/wp-content/uploads/2017/04/Little.SAS_.Book_.A_Primer.Third_.Edition.pdf)

The Handbook of Statistical Analysis Using SAS:

<http://fidy.andrianasy.free.fr/SAS%20Books/++!++%20A%20Handbook%20Of%20Statistical%20Analyses%20Using%20SAS.pdf>

and the SAS programming skills website at Northwestern:

[http://www.kellogg.northwestern.edu/researchcomputing/docs/SAS\\_Programming\\_Skills.pdf](http://www.kellogg.northwestern.edu/researchcomputing/docs/SAS_Programming_Skills.pdf)

PLEASE NOTE: I do require assignments in SAS so that I can give advice and grade them properly.

See below for a more complete list of web sites that provide help for basic math concepts and some of the statistical techniques discussed in this course.

<i>Web Sites with Basic Mathematical and Statistical Help.</i>	
Algebrahelp.com	<a href="http://www.algebrahelp.com/index.jsp">http://www.algebrahelp.com/index.jsp</a>
Derivatives Defined	<a href="http://web.mit.edu/wmath/calculus/isp/ath/unit02.html">http://web.mit.edu/wmath/calculus/isp/ath/unit02.html</a>
Internet Resources for Math	<a href="http://www.langara.bc.ca/mathstats/resource/onWeb/">http://www.langara.bc.ca/mathstats/resource/onWeb/</a>
Linear Algebra Calculator	<a href="http://www.compute.uwlax.edu/lin_alg/">http://www.compute.uwlax.edu/lin_alg/</a>
Logarithms Definition	<a href="http://www.purplemath.com/modules/logs.htm">http://www.purplemath.com/modules/logs.htm</a>
Logarithms Rules	<a href="http://www.purplemath.com/modules/logrules.htm">http://www.purplemath.com/modules/logrules.htm</a>
Arizona Mathematical Software	<a href="http://math.arizona.edu/~www_main_2002/software/azmath.html">http://math.arizona.edu/~www_main_2002/software/azmath.html</a>
Probability and Statistics	<a href="http://www.ability.org.uk/probstat.html">http://www.ability.org.uk/probstat.html</a>
S.O.S. Math	<a href="http://www.sosmath.com/">http://www.sosmath.com/</a>
Derivatives: Rules and Examples	<a href="http://people.hofstra.edu/Stefan_Waner/RealWorld/tccalcp.html">http://people.hofstra.edu/Stefan_Waner/RealWorld/tccalcp.html</a>
Online Statistical Test	<a href="http://www.stat.ucla.edu/~dinov/courses_students.dir/Applets.dir/Normal_T_Chi2_F_Tables.htm">http://www.stat.ucla.edu/~dinov/courses_students.dir/Applets.dir/Normal_T_Chi2_F_Tables.htm</a>

*The following parts of the syllabus are a required template, but also express important principles, procedures, and values.*

### **Penalty for Lateness Clause**

For both undergraduate and graduate courses, instructors are not obliged to accept late work, except where there are legitimate, documented reasons beyond a student's control. In such cases, a late penalty is normally not appropriate.

***In this course, assignments are only accepted up to two days beyond the due date, and at a 10% discount that applies to the entire group working on the assignment.*** Late assignments have historically been a rarity in this course for this reason.

### **Academic Integrity Clause**

Copying, plagiarizing, falsifying medical certificates, or other forms of academic misconduct will not be tolerated. Any student caught engaging in such activities will be referred to the Dean's office for adjudication. Any student abetting or otherwise assisting in such misconduct will also be subject to academic penalties. Students are expected to cite sources in all written work and presentations. See this link for tips for how to use sources well: (<http://www.writing.utoronto.ca/advice/using-sources/how-not-to-plagiarize>).

According to Section B.I.1.(e) of the Code of Behaviour on Academic Matters it is an offence "*to submit, without the knowledge and approval of the instructor to whom it is submitted, any academic work for which credit has previously been obtained or is being sought in another course or program of study in the University or elsewhere.*"

By enrolling in this course, you agree to abide by the university's rules regarding academic conduct, as outlined in the Calendar. You are expected to be familiar with the *Code of Behaviour on Academic Matters* (<http://www.artsci.utoronto.ca/osai/The-rules/code/the-code-of-behaviour-on-academic-matters>) and *Code of Student Conduct* (<http://www.viceprovoststudents.utoronto.ca/publicationsandpolicies/codeofstudentconduct.htm>) which spell out your rights, your duties and provide all the details on grading regulations and academic offences at the University of Toronto.

### **Accessibility Services**

It is the University of Toronto's goal to create a community that is inclusive of all persons and treats all members of the community in an equitable manner. In creating such a community, the University aims to foster a climate of understanding and mutual respect for the dignity and worth of all persons. Please see the University of Toronto Governing Council "Statement of Commitment Regarding Persons with Disabilities" at <http://www.governingcouncil.utoronto.ca/Assets/Governing+Council+Digital+Assets/Policies/PDF/ppno v012004.pdf>.

In working toward this goal, the University will strive to provide support for, and facilitate the accommodation of individuals with disabilities so that all may share the same level of access to opportunities, participate in the full range of activities that the University offers, and achieve their full potential as members of the University community. We take seriously our obligation to make this course as welcoming and accessible as feasible for students with diverse needs. We also understand that disabilities can change over time and will do our best to accommodate you.

Students seeking support must have an intake interview with a disability advisor to discuss their individual needs. In many instances it is easier to arrange certain accommodations with more advance notice, so we strongly encourage you to act as quickly as possible. To schedule a registration appointment with a disability advisor, please visit Accessibility Services at <http://www.studentlife.utoronto.ca/as>, call at 416-978-8060, or email at: [accessibility.services@utoronto.ca](mailto:accessibility.services@utoronto.ca). The office is located at 455 Spadina Avenue, 4<sup>th</sup> Floor, Suite 400.

Additional student resources for distressed or emergency situations can be located at [distressedstudent.utoronto.ca](http://distressedstudent.utoronto.ca); Health & Wellness Centre, 416-978-8030, <http://www.studentlife.utoronto.ca/hwc>, or Student Crisis Response, 416-946-7111.

## **Equity and Diversity**

The University of Toronto is committed to equity and respect for diversity. All members of the learning environment in this course should strive to create an atmosphere of mutual respect. As a course instructor, I will neither condone nor tolerate behaviour that undermines the dignity or self-esteem of any individual in this course and wish to be alerted to any attempt to create an intimidating or hostile environment. It is our collective responsibility to create a space that is inclusive and welcomes discussion. Discrimination, harassment and hate speech will not be tolerated.

Additional information and reports on Equity and Diversity at the University of Toronto is available at <http://equity.hrandequity.utoronto.ca>.



# JAN2020

SUN	MON	TUE	WED	THU	FRI	SAT
			01	02	03	04
05	06	07	08	09	10	11
	Introduction Interactions in Regression	Review: Basic Regression		NO CLASS		
12	13	14	15	16	17	18
	Nonlinear Regression; <i>Downloading NLSY data</i>			Intro to SAS		
19	20	21	22	23	24	25
	Logistic Regression: Binomial, Multinomial <i>Continue SAS</i>			NO CLASS		
26	27	28	29	30	31	
	Logistic Regression: Ordinal			GLM: Poisson and Negative Binomial Regression		

# FEB2020

SUN MON TUE WED THU FRI SAT

01

02 03 04 05 06 07 08

SEM 1:  
Equations  
To  
Models

SEM 2:  
Basic SEM

09 10 11 12 13 14 15

SEM 3:  
Fitting and  
Testing Models

Finish SEM  
Test Review

Exercise 1 Due

16 17 18 19 20 21 22

Reading  
Week

Reading  
Week

Reading  
Week

Reading  
Week

Reading  
Week

23 24 25 26 27 28 29

HLM 1:  
Introduction

Term Test:  
1.5 hours

# MAR2020

SUN	MON	TUE	WED	THU	FRI	SAT
01	02	03	04	05	06	07
		HLM 2: Examples			HLM 3: Generalized HLM	
08	09	10	11	12	13	14
		Generalized HLM Growth Curve Models			Growth Curve Example Intro to Panel Models	
15	16	17	18	19	20	21
		Panel Regression  Exercise 2 Due: SEM			Variations Of Fixed Effects Models	
22	23	24	25	26	27	28
		Fixed Effects in SEM Event History Intro Exercise 2 Due: HLM			Event History Intro	
29	30	31				
		Event History Example Final Review				

# APR 2020

SUN	MON	TUE	WED	THU	FRI	SAT
			01	02		03 04
					Final Test	
05	06	07	08	09	10	11
	Exercise 2 Due: Panel Regression					
12	13	14	15	16	17	18
19	20	21	22	23	24	25
					Any Exercise 3 Due: Any Topic not Ex. 2	
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