DEPARTMENT OF CITY AND REGIONAL PLANNING
University of North Carolina at Chapel Hill

PLAN 721: Advanced Planning Methods

Professor Todd BenDor
Email: bendor@ unc.edu
Phone: 962-4760
Office Hours: 2:00 – 3:00 T,TH, appointment
Office: New East 307

Teaching Assistant: Lilah Besser
Email: lbesser@email.unc.edu
Office Hours: 10:30-12 F, appointment
Office: New East Computer Lab (2nd Floor)

Spring 2009
5:00 – 6:15 MW
Lecture, New East Rm. 102
3:30 – 4:45 TH
Lab, New East Computer Lab

http://blackboard.unc.edu

Objectives

This course is a continuation of PLAN 720 and focuses on improving the analytical repertoire of planning students by examining several advanced statistical techniques and surveying several basic topics in system dynamics computer simulation modeling. The goal of this course is to enhance student knowledge and skills in order to better understand planning problems, properly obtain and analyze data, and correctly interpret and present analysis results. Specifically, this course introduces topics in linear regression, logistic regression, time series analysis, count modeling, and system dynamics modeling. These topics will serve as important background for students' future courses in transportation and economic development planning. The course will further familiarize students with the use of Microsoft Excel spread sheets, as well as introduce students to statistical analysis using STATA (http://www.stata.com/), and introduce system dynamics modeling through the STELLA modeling platform.

After taking the course students should be able to clearly analyze planning problems and issues using sophisticated statistical methods, as well as better understand complex feedback dynamics and their policy implications. Moreover, they should be able to support planning decisions based on empirical data and draw logical conclusions from statistical analysis. Finally, students should have a better understanding of feedback and its non-intuitive effects within social and physical systems, as well as an understanding of how to quantify causal relationships in dynamic, complex systems.

We will maintain a course website that will contain course information, course readings, handouts, data and links to relevant websites. This website can be found at: http://blackboard.unc.edu/.

Approach

Quantitative methods are widely used in both public and private sector planning to inform decisions and build knowledge. This process is important since it helps reduce uncertainty in decision-making. Accordingly, this course emphasizes the following themes that are central to solving quantitative problems:

1. In order to solve planning problems, they need to be structured. Structuring a problem means that you must develop a plausible conceptual structure of a problem, usually by hypothesizing ('guess') and operationalizing ('quantify and put into action') the nature of relationships between the variables in a system. Think: "How do things affect each other in systems I am dealing with?"
2. Having structured the problem, researchers need to design their investigation and collect data on important variables. The data can be obtained from secondary sources (such as the U.S. Census) or primary sources (e.g. telephone interviews, mail-back surveys of the selected population, or measurements in the landscape).
3. The data needs to be described, visualized and presented in a coherent manner.
4. Statistical tools are used to understand the nature and properties of specific variables and their inter-relationships. There can be considerable variation in the applicability of specific statistical methods, depending on the definition of the problem and availability of data.
5. Planners need to draw logical implications from statistically based studies (for decision-making) and understand a study's contributions to planning knowledge, debate and human progress.

We will strive to help you think about planning issues in rigorous statistical terms. The statistical methods taught in the class will provide one of the key lenses with which you can view and analyze planning problems and evaluate solutions. You will learn about techniques that can help you make decisions in complex planning situations, where you can use powerful methods to develop insights, understand key relationships and predict outcomes. We will emphasize the application and interpretation of statistical concepts and output rather than mathematical theory.

Course Prerequisites

This is a required course for first year economic development and transportation planning students (3 credits). PLAN 720 (or equivalent training in basic statistics) is a required prerequisite for this course. This course becomes more mathematically intensive than PLAN 720, but all evaluations will focus on the correct interpretation and application of techniques rather than theory.

Course Requirements and Grading

Policy on Late or Incomplete Work: In order to be fair to your fellow students (particularly in light of the extensive time requirements of this course), **late assignments will not ordinarily be accepted**. Zero points will be assigned to work not completed on time.

Grades of incomplete may be given in the event of a medical or other emergency. In these cases, a written application for an incomplete on any assignment, including the term project, must state the reasons for the request and propose a new deadline.

The University's Honor Code is in effect. The University of North Carolina at Chapel Hill has had a student-administered honor systems and judicial system for over 100 years. Because academic honesty and trustworthiness are important to professional planning, this is a significant University and Departmental tradition. Your attention is called to the Instrument of Student Judicial Governance for policies and procedures pertaining to the honor system. Please consult with the instructor if you are uncertain about your responsibilities under that code with respect to this course.

Assignments are expected to be completed individually. Discussions with classmates about assignments are encouraged, but all final work must be entirely your own.

The requirements for the course include:

- Attendance, readings and active class participation (10% of the grade).
- Assignments (50% of the grade; 10% each [5]).
- In-Class Quizzes (20% of the grade; 2% each [10]).
- Final Exam (20% of the grade)

Assignments will include exercises that familiarize you with the methods of statistical modeling that we discuss in class. Assignments are intended to help students understand the class materials and students are thus expected to work on them individually. **Students can share ideas, but must ultimately reach a conclusion by themselves and hand back their own answer sheet.** Assignments will be handed out (and due back) according to the schedule below.

- **Late homework assignments will not be accepted.**
- All assignments must be completed **individually**.
- You are expected to **show all work** on your assignments.
- Assignments should be turned in to my mail box by 5 pm on the due date.
- Please contact the instructor or TA if you have any questions, problems with the readings or the course, or any other issues that you wish to discuss
- Any student who feels s/he may need an accommodation based on the impact of a disability should contact me privately early in the semester to discuss your specific needs. Students

with documented disabilities should contact the Department of Disability Services at 919-962-8300 (SASB North, Suite 2126) to coordinate reasonable accommodations.

- **Please arrive on time and turn off cell phones in class**

Quizzes will be given in class and will consist of several short answer and multiple choice questions on your knowledge of both the readings and the previous lectures. Quizzes will be announced beforehand and must be completed individually.

There will be one final exam that will test students' knowledge of how to use and interpret the regression models presented in this course. This exam will take place during the last class period of the semester (April 27).

Final grades are based on this scale:

H (90+ points)	L (65+ points)
P (75+ points);	F (64 or fewer points).

Grading Notes:
Generally, an **H** grade is given for exceptional work that demonstrates a real mastery of course material. **L** or **F** work substantially fails to meet minimum requirements either due to incomplete coverage of required information, incorrect results, or sloppy, unprofessional reporting of results.

Course Materials

Required:

1. J. Scott Long and Jeremy Freese. 2006. Regression Models for Categorical Dependent Variables Using Stata (2nd Edition). College Station, TX: Stata Press.
2. Peter Kennedy. 2003. A Guide to Econometrics (5th Edition). Cambridge, MA: MIT Press
3. Andrew Ford. 2009. Modeling the Environment: An Introduction to System Dynamics Modeling of Environmental Systems (2nd Edition). Washington, D.C.: Island Press.
   This text has not been published yet. For this course we have received permission to use a pre-published copy which can only be purchased at the bookstore (at cost of duplication).

Additional:

Kenneth Train. 2003. Discrete Choice Methods with Simulation. Cambridge, England: Cambridge University Press. [Online]. Available: http://elsa.berkeley.edu/books/choice2.html
This (now **free**!) book contains lots of information on discrete choice modeling and particularly useful for transportation planning issues.

Additional reading materials and links will be posted on the course Blackboard website.

Administrative Issues

Software and Data

Unlike some of the work you did in PLAN 720, many of the analyses we will use in this course are nearly impossible to complete by hand. Important statistical software tools that we will use in the DCRP computer lab include:

- **Stata** – sophisticated statistical analysis software that is available in the DCRP computer lab (version 10), ODUM computer lab, and the Citrix server on the OASIS website (Version 8; Free stats analysis in your own home!). Note: **Version 10 data is not backward compatible with Version 8.**

  If you are having problems with Stata, tutorials to better acquaint you with the software are available at:
  http://www.ats.ucla.edu/stat/stata/
  http://www.cpc.unc.edu/services/computer/presentations/statatutorial
  http://www.stata.com/links/resources1.html

- **STELLA** – system dynamics modeling software used to graphically represent complex feedback systems (Citrix uses v. 7, which is not backward compatible with v. 8 or 9).

Additional Useful Software Available:

- For those of you who are familiar with it, **SPSS** (Statistical Package for Social Scientists) is also installed in the lab. To learn this software this you can: 1) Check the course website for tutorials or 2) The help menu in SPSS has a tutorial.
- **Vensim PLE** (Personal Learning Edition; http://www.vensim.com/) is another sophisticated dynamic modeling package that is freely available online. It is not compatible with STELLA and has a sharper learning curve, but it can perform many of the same (and additional) functions.
- Many interesting, non-spatial analyses can be extracted from GIS data. If you want to do GIS analysis from home, the **Quantum GIS application** (http://www.qgis.org/) is a free, open source GIS package that allows you to avoid buying or dealing with ArcGIS.

Citrix Server

To use the Citrix web applications, you will need to first install the Citrix client web application onto your computer – you can find this client at:
https://aswww2.oasis.unc.edu/Citrix/AccessPlatform/clientDetection/downloadNative.aspx

Access http://oasis.unc.edu/ through Internet Explorer (you may have problems with Firefox!) and click the link for Citrix Applications (left side of page). **You will enter your Onyen and computer lab password.**

Course Outline

*****Students should read the assigned material before each class*****

Section 1: Statistics Overview

January 12. Class 1: Course Overview and Introduction

- **Review of PLAN 720 textbook or other statistics textbooks** – inferential statistics (central tendency and dispersion, hypothesis testing, and ANOVA)
  Two that are on reserve in the planning library:
  - Berman, Evan. 2007. *Essential Statistics for Public Managers and Policy Analysts (2nd edition)*. CQ Press: Washington, D.C.
  - Ken Meier and Jeffrey Brudney. 2002. Applied Statistics for Public Administration (5th edition). Harcourt College Publishers: Fort Worth, TX.
- **Blackboard:** Alan Acock, *A Gentle Introduction to Stata*, Chapter 1 (begins to overview the statistics software we will be using in this course)

January 14. Class 2: Statistics Overview - 'Who remembers PLAN 720?'

- Kennedy, *A Guide to Econometrics*, Chapter 1, Pgs. 1-6.
- **Blackboard:** Alan Acock, *A Gentle Introduction to Stata*, Chapter 3-5.
- Long and Freese, Chapter 1 (Section 1.5): What Software do you Need? Pgs. 7-13.

Section 2: Linear Regression Analysis

Part 1: Bivariate Linear Regression

January 21. Class 3: Introduction to OLS

- Kennedy, *A Guide to Econometrics*, Chapter 2 and 3 (pgs. 11-28 and 47-52)
- Long and Freese, Chapter 2: Introduction to Stata. Pgs. 15-71.
  - Skim this reading - this chapter augments reading from Acock, *A Gentle Introduction to Stata*.

QUIZ #1: Review of basic statistics

Additional Sources:

- ***On Reserve in Chapin Library***: Berry, William. 1993. Understanding Regression Assumptions. Sage: Newbury Park, CA. *For those of you interested in a longer exploration of the assumptions of linear regression.*

January 26 and 28. Class 4 and 5: Assumptions and Interpretation

- **Blackboard:** Berman, Evan. 2007. *Essential Statistics for Public Managers and Policy Analyst*s. Chapter 12: Simple Regression. Pgs. 198-210.
- **Blackboard:** Lewis-Beck, Michael. 1989. *Applied Regression: An Introduction*. Chapters 1 and 2: Bi-Variate Regression. Pgs. 1-47.

Part 2: Multivariate Linear Regression

February 2. Class 6: Introduction to Multivariate Linear Regression

- **Blackboard:** Acock, *A Gentle Introduction to Stata*, Chapter 10 (10.1-10.3)
- **Blackboard:** Lewis-Beck, Michael. 1989. Applied Regression: An Introduction. Sage: Newbury Park, CA. Chapter 3: Multivariate Regression. Pgs. 47-74
- **Blackboard:** Stata Corporation. Linear Regression Entry. 2005. Base Reference Manual (Release 9), Volume 1. College Station, TX: Stata Press. Pgs. 60-107. Pgs. 35-98.

QUIZ #2: Bivariate regression

February 4. Class 7: Model Building and Multicollinearity

- Kennedy, *A Guide to Econometrics*, Chapter 6 (Non-linearities; Pgs. 107-114), Chapter 7 (Nonzero Expected Disturbance; Pgs. 129-131), Chapter 8 (Non-spherical errors; Pgs. 133-144;), and Chapter 11 (Multicollinearity; Pgs. 205-212).
- **Blackboard:** Acock, *A Gentle Introduction to Stata*, Chapter 10 (10.4-10.6)

February 9. Class 8: Transformations and Important Data Points

- **Blackboard:** Acock, *A Gentle Introduction to Stata*, Chapter 10 (10.7-10.11)

QUIZ #3: Multivariate regression

Section 3: Logistic Regression

Part 1: Binary Logistic Regression

February 11 - 18. Class 9 - 11: Usage and Interpretation of Binary Logit Regression

- Kennedy, *A Guide to Econometrics*, Chapter 15 (15.1 – Dichotomous Regression, 259-261).
- Long, J. Scott and Jeremy Freese, Chapter 4: Models for Binary Outcomes. Pgs 131-181.
- **Blackboard:** Berman, Evan. 2007. Essential Statistics for Public Managers and Policy Analysts. Chapter 14: Logistic Regression. Pgs. 235-265.
- **Blackboard:** Rogerson, Peter A. 2001. Statistical Methods for Geography. London, UK: Sage. Section 7.6 – 7.8: Categorical Dependent Variable. Pgs. 140-150.

- **Stata Reference, Blackboard:** Stata Corporation. Logistic and Logic Regression Entries. 2005. Base Reference Manual (Release 9), Volume 2. College Station, TX: Stata Press. Pgs. 60-107.
- **Blackboard:** Acock, *A Gentle Introduction to Stata*, Chapter 11.
- **Online:** UCLA Stata Website. Stata Topics: Logistic (and Categorical) Regression. Available: http://www.ats.ucla.edu/stat/stata/topics/logistic_regression.htm

Part 2: Ordered (Ordinal) Logistic Regression

February 23, 25. Class 12-13: Usage and Interpretation of Ordered Logit Regression

- Kennedy, *A Guide to Econometrics*, Chapter 15 (15.2 – Ordered Regression; Pgs. 262-263).
- Long, J. Scott and Jeremy Freese, Chapter 5: Models for Ordinal Outcomes. Pgs. 183-220 (until 5.9).
- **Stata Reference, Blackboard:** Stata Corporation. Ordered Logistic Regression Entries. 2005. Base Reference Manual (Release 9), Volume 2. College Station, TX: Stata Press. Pgs. 340-350.
- **Online:** Introduction to Stata. UCLA: Academic Technology Services, Statistical Consulting Group. Stata Annotated Output: Ordered Logistic Regression [Online]. Available: http://www.ats.ucla.edu/stat/stata/output/stata_ologit_output.htm
- **Online:** Introduction to Stata. UCLA: Academic Technology Services, Statistical Consulting Group. Stata Data Analysis Examples: Ordinal Logistic Regression. [Online]. Available: http://www.ats.ucla.edu/stat/stata/dae/ologit.htm

February 23: QUIZ #4: Binomial logistic regression

Part 3: Unordered (Multinomial) Logistic Regression

March 2-5. Class 14-16: Course Overview and Introduction

- Kennedy, *A Guide to Econometrics*, Chapter 15 (15.3 – Multinomial Regression; Pg. 263).
- Long, J. Scott and Jeremy Freese, Chapter 6: Models for Nominal Outcomes. Pgs. 223-257 (until 6.6.6).
- **Stata Reference, Blackboard:** Stata Corporation. Unordered (Multinomial) Logistic Regression and Maximum Likelihood Entries. 2005. Base Reference Manual (Release 9), Volume 2. College Station, TX: Stata Press. Pgs. 186-227.
- **Online, Blackboard:** Newton, Joseph. 2000. Interpreting logistic regression in all its forms (in Adobe .pdf form) (from Stata STB53, Courtesy of, and Copyright, Stata Corporation). [Online]. Available: http://www.ats.ucla.edu/stat/stata/library/sg124.pdf
- **Online:** Introduction to Stata. UCLA: Academic Technology Services, Statistical Consulting Group. Stata Data Analysis Examples: Multinomial Logistic Regression. [Online] Available: http://www.ats.ucla.edu/stat/stata/dae/mlogit.htm

- **Online:** Introduction to Stata. UCLA: Academic Technology Services, Statistical Consulting Group. Stata Annotated Output: Multinomial Logistic Regression. [Online] Available: http://www.ats.ucla.edu/stat/stata/output/stata_mlogit_output.htm

March 2: QUIZ #5: Ordinal logistic regression

Additional Reading:

- **Online, Blackboard:** Hahn, Eugene D. 2005. Probit and Logit Models: Differences in the Multivariate Realm. The Journal of the Royal Statistical Society, Series B (In review): [Online]. Available: http://home.gwu.edu/~soyer/mv1h.pdf

Section 4: Time Series and Count Modeling

Part 1: Time Series Analysis

March 16. Class 17: Time Series Analysis

- **Blackboard:** Berman, Evan. 2007. Essential Statistics for Public Managers and Policy Analysts. Chapter 15: Time Series Analysis. Pgs 245-265.
- **Blackboard:** Meier, Kenneth J. 2002. Applied Statistics for Public Administration. Fort Worth, TX: Harcourt College Publishers. Chapter 22: Interrupted Time Series: Program and Policy Analysis. Pgs. 383—400.
- **Stata Reference, Blackboard:** Stata Corporation. TSSET – Declare Data to be Time Series Data. 2005. Time Series Reference Manual (Release 9). College Station, TX: Stata Press. Pgs. 228-237.

Additional Reading

- Kennedy, *A Guide to Econometrics*, Chapter 18 (Time Series Econometrics; Pg. 319-328).

QUIZ #6: Multinomial logistic regression

Part 1: Count Modeling

March 18. Class 18: Count Data Modeling (Guest Lecture – Noreen McDonald)

- Kennedy, *A Guide to Econometrics*, Chapter 15 (15.4 – Count Modeling; Pgs. 263, 279).
- Long, J. Scott and Jeremy Freese, Chapter 8: Models for Count Outcomes. Pgs. 349-387 (end of 8.4).
- **Online, Blackboard:** Cameron, Colin A. Count Data Regression Made Simple. [Online]. Available: http://cameron.econ.ucdavis.edu/racd/simplepoisson.pdf
- **Stata Reference, Blackboard:** Stata Corporation. Poisson and Negative Binomial Regression Entries. 2005. Base Reference Manual (Release 9), Volume 2. College Station, TX: Stata Press. Pgs. 246-259, 431-444.

- **Online:** Introduction to Stata. UCLA: Academic Technology Services, Statistical Consulting Group. Stata Annotated Output: Poisson Regression. [Online]. Available: http://www.ats.ucla.edu/stat/stata/output/stata_poisson_output.htm

Section 5: System Dynamics Modeling

Part 1: Introduction to System Dynamics

March 23. Class 19: Introduction to Modeling

- Andrew Ford, Modeling the Environment: An Introduction to System Dynamics Modeling of Environmental Systems, Chapter 1 and 2 (Overview; Software Introduction: Getting Started with Stella and Vensim).

Additional Reading:

- Sterman, J. D. (1991). A Skeptic's Guide to Computer Models. In Barney, G. O. et al. (eds.), Managing a Nation: The Microcomputer Software Catalog. Boulder, CO: Westview Press, 209- 229.

QUIZ #7: Time series and count modeling

March 25-30. Class 20-21: Stocks and Flows (Software demonstration)

- Andrew Ford, Modeling the Environment: An Introduction to System Dynamics Modeling of Environmental Systems, Chapter 3 and 4 (Stocks and Flows: The Building Blocks of System Dynamics Models; Accumulating the Flows).

Additional Reading:

- Deaton, Michael and James Winebrake. 2000. Dynamic Modeling of Environmental Systems. New York, NY: Springer-Verlag. Chapter 1: Overview of Environmental Systems and Chapter 2: Basic Modeling Concepts in Environmental Systems. Pgs 1-65.

April 1. Class 22: Dynamic Equilibrium and System Archetypes

- Andrew Ford, Modeling the Environment: An Introduction to System Dynamics Modeling of Environmental Systems, Chapter 6 and 7 (Equilibrium Diagrams and S-Shaped Growth).

QUIZ #8: Basic elements of system dynamics

Part 2: Positive and Negative Feedback

April 6. Class 23: Introduction to Feedback

- Andrew Ford, Modeling the Environment: An Introduction to System Dynamics Modeling of Environmental Systems, Chapter 9 (Information Feedback and Causal Loop Diagrams).

Additional Reading:

- **Blackboard:** Sterman, J. D. Business Dynamics: Systems Thinking and Modeling for a Complex World. Boston, MA: Irwin McGraw-Hill. Chapter 5: Causal Loop Diagrams. Pgs. 137-190.

Reading for Lab (Thursday):

- Andrew Ford, Modeling the Environment: An Introduction to System Dynamics Modeling of Environmental Systems, Chapter 5 (Case #1. Water Flows in the Mono Basin).

April 8. Class 24: Feedback Loops and Homeostasis

- Andrew Ford, Modeling the Environment: An Introduction to System Dynamics Modeling of Environmental Systems, Chapter 10 (Homeostasis).

QUIZ #9: Feedback in system dynamics modeling

April 13. Class 25: The Modeling Process and First Policy Application

- Andrew Ford, Modeling the Environment: An Introduction to System Dynamics Modeling of Environmental Systems, Chapter 13, 14, and 16 (The Modeling Process; Software: Further Progress with Stella and Vensim; Managing a Feebate Program for Cleaner Vehicles).

Part 3: Policy Development: Application to Urban Dynamics and Climate Change

April 15. Class 26: Introduction to Cyclical Behavior

- Andrew Ford, Modeling the Environment: An Introduction to System Dynamics Modeling of Environmental Systems, Chapter 18 and 19 (Introduction to Cyclical Behavior; Cycles in Real-Estate Construction).

April 20-22. Class 27-28: *Urban Dynamics* and Climate Change

- **Blackboard:** Collins, John F. 1974. Chapter 1: Managing Our Cities – Can We Do Better? In: Readings in Urban Dynamics: Volume 1. Edited by Nathaniel Mass. Cambridge, MA: MIT Press. Pgs 3-11.
- **Blackboard:** Schroeder III, Walter W. Chapter 3: Urban Management Actions. In: Readings in Urban Dynamics: Volume 2. Edited by Walter W. Schroeder III, Robert E. Sweeney, and Louis Edward Alfeld. Cambridge, MA: MIT Press. Pgs. 31-48

- Andrew Ford, Modeling the Environment: An Introduction to System Dynamics Modeling of Environmental Systems, Chapter 23 (CO2 in the Atmosphere).

April 20: QUIZ #10: Cyclical behavior in system dynamics models

April 27. Class 29: ***FINAL EXAM***

Assignment and Lab Schedule

Quizzes (almost weekly)

QUIZ #1: Review of basic statistics (January 21)
QUIZ #2: Bivariate regression (February 2)
QUIZ #3: Multivariate regression (February 9)
QUIZ #4: Binomial logistic regression (February 23)
QUIZ #5: Ordinal logistic regression (March 2)
QUIZ #6: Multinomial logistic regression (March 16)
QUIZ #7: Time series and count modeling (March 23)
QUIZ #8: Basic elements of system dynamics (April 1)
QUIZ #9: Feedback in system dynamics modeling (April 8)
QUIZ #10: Cyclical behavior in system dynamics models (April 20)

Assignments

HW	Handed Out	Due Date	Topic
1	30-Jan	16-Feb	Multivariate Regression
2	18-Feb	4-Mar	Logistic Regression I
3	5-Mar	23-Mar	Logistic Regression II/Time Series/Count Modeling
4	23-Mar	8-Apr	Dynamic Modeling I
5	8-Apr	22-Apr	Dynamic Modeling II

Computer Lab Sessions*

Computer lab sessions will be offered during the semester to help familiarize students with the software packages that will be used in the class. The schedule of these lab sessions is given below.

Lab	Date	Topic
1	5-Feb	Linear Regression (STATA)
2	19-Feb	Binary Logistic Regression (STATA)
3	26-Feb	Polytomous Logistic Regression (STATA)
4	9-Apr	Dynamic Modeling I (STELLA)
5	16-Apr	Dynamic Modeling II (STELLA)

***Note:** Lab sessions will be held Thursday 3:30 to 4:45 PM at the New East Computer Lab (2nd Floor).