August 1, 2016

LBJ SCHOOL OF PUBLIC AFFAIRS

Introduction to Empirical Methods for Policy Analysis

Fall Semester 2016

FACULTY	Robert H. Wilson
COURSE	PA 397 (60935)
MEETING TIME	Monday, 9:00-12:00
ROOM	SRH 3.122
OFFICE HOURS	Wednesdays 1:30-3:00; SRH 3.222
EMAIL	rwilson@austin.utexas.edu
TEACHING ASSISTANT	Cale Reeves
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OVERVIEW

Students will develop an understanding of the application of quantitative tools in public management and policy analysis in the course. Given that mathematical methods are a primary mechanism for integrating quantitative information in evidence-based policy making and management, a wide range of applications, as well as limitations of these methods, will be addressed. In this particular section of IEM, a modeling approach to the application of quantitative methods is adopted and students will develop skills in conceptualizing problems in mathematical and graphical forms and integrating quantitative information to make these forms operational. An emphasis on learning through problem solving is adopted in this section.

The course is organized around two primary topics: modeling for (1) public management decision-making and (2) statistical analysis. The topics are addressed through applications such as constrained optimization based on calculus and linear programming; policy choices using probabilistic information; evaluating and updating information using Bayesian techniques; descriptive and inferential statistics; forecasting; and regression analysis. Students will be introduced to software (Stata and several Excel Add-ins) that facilitates the application of quantitative modeling.

Students typically take this course in the fall semester of the first year. Prerequisites in college-level algebra, calculus, and statistics must be completed before enrolling in this course. Some use will be made of summation notation and basic matrix algebra. In the second of the two-course sequence, students will develop more specialized knowledge and skills in a particular set of quantitative methods. In addition to serving as a foundational course for the quantitative methods sequence, this course will provide quantitative skills used in other courses in the MPAff curriculum.

COURSE REQUIREMENTS AND STUDENT EVALUATION

Student progress will be evaluated on three types of work: (1) 4 problem sets (40% of the final grade) are designed to demonstrate competency over fundamentals and to provide practice in the application of quantitative methods to problems of public policy; (2) two exams, mid-term and final (each accounting for 25%); and (3) class participation (10%).

Due dates for Problem Sets

Homework #1: T 1, 2, 3	September 23, 5:00 pm
Homework #2: T 4, 5, 6	October 14, 5:00 pm
Homework #3: T 7, 8, 9	November 11, 5:00 pm
Homework #4: T 10, 11, 12	December 2, 5:00 pm

CLASS SCHEDULE

August 29:	T1: Introduction to course and to management science and optimization
September 12:	T2: Linear programming
September 19:	T3: Other forms of mathematical programming
September 26:	T4: Descriptive statistics, probability theory, random variables
October 3:	T5: Introduction to decision theory, decision trees, value of information
October 10:	T6: Decision mathematics, utility theory
October 17:	Mid-term examination
October 24:	T7: Statistical Inference I: Sampling, point estimation
October 31:	T8: Statistical Inference II: Confidence intervals, hypothesis testing
November 7:	T9: Statistical Inference III: Analysis of Variance, non-parametrics
November 14:	T10: Bivariate Regression I: Estimation
November 21:	T11: Bivariate Regression II:Assumptions, inference, time series data
November 28:	T12: Multiple Regression I: Properties of estimators, inference
December 5:	T13: Multiple Regression II: Non-linear regression, analyzing results
December 7:	Final examination

TEACHING ASSISTANT HOURS AND SESSION

The course Teaching Assistant (TA), Cale Reeves, will hold both weekly review/application sessions and office hours.

1) **Review/application sessions** will be held weekly for two hours (day and time to be determined). The goals of these sessions are to:

    a. Review and clarify key concepts
    b. Acclimate students to the use of analytical software tools
    c. Gain proficiency in the application of these concepts

    These sessions will be planned in advance and in response to questions/concerns raised by students. Students planning to attend these sessions will be asked to submit questions or raise particular issues they wish to discuss; otherwise,

activities will focus on topics the TA deems most relevant. The session will be conducted as a "hands-on" review during which students will work in groups or pairs (under the instruction and guidance of the TA) to answer questions/solve problems pertaining to the topics covered—and often drawing upon examples/data used—in that week's class. (Note: homework questions will not be addressed in these sessions.)

2) **Office hours** will be primarily one-on-one and will take place by appointment (either in person or by Skype); this format is ideal for those students needing help with an obscure or more in-depth issue/topic, or for those who are unable to attend the more comprehensive review/application session.

   A note on software: The TA is available for one-on-one help regarding software issues with Excel and Stata, and to meet in person to troubleshoot, but please note the following:
   a. Software questions will be addressed in the weekly review/application sessions.
   b. Many questions can be answered in the "How To" documentation prepared for this class (on Canvas). Please check here first on software questions.
   c. Finally, both Excel and Stata have excellent online forums for troubleshooting. A Google search can also provide useful information that should be explored before requesting a meeting.

STUDENTS WITH DISABILITIES

The University of Texas at Austin provides, upon request, appropriate academic accommodations for qualified students with disabilities. For more information, contact Services for Students with Disabilities (SSD), at (512) 471-6259 [voice] or (866) 329-3986 [videophone].

IMPORTANT NOTE ON ACADEMIC INTEGRITY

Students are expected to respect the LBJ School's standards regarding academic dishonesty. You owe it to yourself, your fellow students, and the institution to maintain the highest standards of integrity and ethical behavior. A discussion of academic integrity, including definitions of plagiarism and unauthorized collaboration, as well as helpful information on citations, note taking, and paraphrasing, can be found at the web page of the Office of the Dean of Students (http://deanofstudents.utexas.edu/sjs/acint_student.php) and the Office of Graduate Studies (http://www.utexas.edu/ogs/ethics/transcripts/academic.html). The University has also established disciplinary procedures and penalty guidelines for academic dishonesty, especially Sec. 11.304 in Appendix C of the Institutional Rules on Student Services and Activities section in UT's General Information Catalog.

TEXTS

The **required text** for this course is:

Meier, Kenneth J., Jeffrey L Brudney, and John Bohte (2015, 9th ed.), *Applied Statistics for Public and Nonprofit Administration*, Cengage.

The course will also refer to selections from other textbook, copies of which will be made available on Canvas:

Used Extensively:

Robert T. Clemen and Terence Reilly (2001). *Making Hard Decisions: An Introduction to Decision Analysis,* Duxbury

McKenna, Christopher K. (1980). *Quantitative Methods for Public Decision Making*. McGraw Hill Co.

Thomas Wonnacott & Ronald Wonnacott (1990). *Introductory Statistics*, 5th Ed

Used Occasionally:

Anderson, David R., Dennis Sweeney and Thomas Williams, (2004, 9th edition) *Quantitative Methods for Business,* Thomson, Southwestern.

Hanushek, Eric and John Jackson (1977), *Statistical Methods for Social Scientists* New York: Academic Press.

Moore, David S. and George P. McCabe (1993), *Introduction to the Practice of Statistics* New York: W. H. Freeman and Company.

Tufte, Edward (1974) *Data Analysis for Politics and Policy* Englewood Cliffs, N.J.: Prentice-Hall.

COMPUTER SOFTWARE

Although the course will utilize computer software throughout the semester, there are no specific learning objectives concerning knowledge and competency in the use of software. Rather software will be utilized to help develop knowledge of specific techniques and as a tool to help solve complex problems. Several Excel add-ins will be used for the management science topics and Stata for statistical modeling topics. To repeat, students will not be tested on their knowledge of the software utilized in the course.

READINGS

Students are expected to complete the readings prior to the class. A copy of class notes will be provided on CANVAS for some sessions. These notes contain the concepts and formulas used in the session.

August 29: T1: Introduction: To the course and to management science

Topics:

Art of data analysis and its role in decision making
Mathematical and statistical modeling
Optimization and decision-making
Introduction to linear programming

Required reading:

- McKenna chs. 1 and 8
- Meier, Brudney, and Bohte, ch 1.
- Fienberg, S. (2014), "What is Statistics?" *Annual Review of Statistics and Its Application*, 1:1-9
- Hanushek, E. and J. Jackson (1977), *Statistical Methods for Social Scientists*, pp. 1-13
- S. Harris, "Linear Programming Graphic Tutorial", www.msubillings.edu/BusinessFaculty/Harris/LP_Problem_intro.htm
- Handout: Lagrange multipliers

September 12: T2: Linear Programming

Topics:

Graphical solutions to linear programming
Sensitivity analysis
The Simplex method
Transportation modeling: a linear programming approach

Required reading:

- McKenna, chs. 9 (including the appendix) and 10 (skim)
- D. Anderson, D. et al (2004), "Transportation, Assignment and Transshipment Problem", *An Introduction to Management Science*. ch. 10.1, 10.3
- Handout: Guidelines for Excel/Solver and inspector problem solution

September 19: T3: Other Forms of Mathematical Programming

Topics

Introduction to multi-objective programming
Goal Programming
Project Management: a Network Model

Required reading:

- McKenna, chs. 11 and 12
- Handout: Solver solution for university admissions problem

September 26: T4: Descriptive statistics, probability theory, random variables

Topics:

Tools for summarizing, displaying and exploring data
Central tendency, dispersion and shape

Probability theory and Bayes rule
Random variables and expected values
Bernoulli distribution

Required reading:

- Meier, Brudney, and Bohte, chs. 2, 4, 5, 6, 8 (pp 145-151) (a quick read, as review)
- Wonnacott and Wonnacott chs. 3.1-3.6, 4.1-4.2, and 5.1
- J. Schwabish (2014), "An Economist's Guide to Visualizing Data" *Journal of Economic Perspectives*, vol. 28, no. 1, 209-234
- Handouts: Accessing Stata, Using Stata, Code book for Education data set

October 3: T5: Introduction to decision theory, decision trees, value of information

Topics:

Uncertainty, risk and consequences
Decision trees: Choices, payoffs and decision rules
Value of perfect and imperfect information

Required reading:

- McKenna, chs 4 and 5
- Clemen and Reilly, chs 1, 3 (pp. 65-79, skip p. 76); 4 (pp. 111-119; 128-137; 12 (pp. 496-511)

October 10: T6: Utility theory and simulation

Topics:

Utility functions
Multiple objectives
Monte Carlo simulation

Required reading:

- McKenna, ch 6, 14
- Clemen and Reilly, chs. 13 (527-546), 15
- D. Anderson, et al (2004), "Simulation," *An Introduction to Management Science*. ch 15.

October 24: T7: Statistical Inference I: Sampling, point estimation

Topics:

Sampling distributions
Normal distribution
Central limit theorem
Properties of estimators
Bias and efficiency in estimators

Required reading:

- Meier, Brudney, and Bohte, chs. 7, 10 and 12

- Wonnacott and Wonnacott, ch. 7.1, 7.2, 7.4
- Properties of estimators—Gujarati and Porter, A.3, A.8, A.10, A.11

October 31: T8: Statistical Inference II: Confidence Intervals, hypothesis testing, difference in means

Topics:

Constructing confidence intervals-single mean and difference in means
Classical hypothesis testing, types of error
Student-t statistics
p-values
Bootstrap distributions

Required reading:

- Meier, Brudney, and Bohte, 11, 13
- Wonnacott and Wonnacott, chs. 8 and 9.1-9.3.
- Handouts: Summary of Inferential Statistics; Confidence Internals, Difference in Means using Stata

November 7: T9: Statistical Inference III: Analysis of variance, non-parametric and robust statistics

Topics:

Testing for differences in means with multiple variables
Explained and unexplained variation
Assessing goodness of fit, R^2, F-test
Relaxing assumptions about distributions
Contingency tables and chi-square tests

Required reading:

- Meier, Brudney, and Bohte, chs 14, 15
- Wonnacott and Wonnacott, chs. 10.1, 10.2, 16.2, 16.4
- Handouts: χ^2; ANOVA

November 14: T10: Bivariate Regression I: Estimation

Topics:

Fitting a line
Correlation and covariation
Ordinary least squares
Interpreting coefficients
Properties of estimators
Goodness of fit and sources of error

Required reading:

- Meier, Brudney, and Bohte, chs. 16 and 17
- Wonnacott and Wonnacott, chs. 11.1, 11.2, and 15.1, 15.2.
- Tufte, pp. 78-88

- Handouts: Cross Products; Estimation of a Simple Regression Model; Derivation of Ordinary Least Squares

November 21: T11: Bivariate Regression II: Inference, Assumptions and Time Series

Topics:

Assumptions of OLS
Confidence Intervals
Hypothesis testing
Time Series

Required Readings

- Meier, Brudney, and Bohte, chs. 18, 19
- Wonnacott and Wonnacott, chs. 12.2, 12.3, 12.4.
- Handout: Problems of Regression Analysis

November 28: T12: Multiple Regression I

Topics:

Controlling for a third variable
Ordinary least squares revisited
Properties of estimators, assumptions of OLS once again
Confidence Intervals
Hypothesis testing
Dummy variables

Required reading:

- Meier, Brudney, and Bohte, ch. 20 (except 406-411);
- Wonnacott and Wonnacott, ch. 13.3, 13.5. 14.1-14.2
- Hanushek, pp. 35-38
- Tufte, pp. 135-148
- Handouts:F-test with additional explanatory variables; Stata with dummy variable; Stata output explained

December 5: T13: Multiple Regression II

Topics:

Non-linear regression
Assumptions of OLS
Analyzing results and residuals

Required reading:

- Meier, Brudney, and Bohte, pp. 406-411, 426-432
- Wonnacott and Wonnacott, ch. 14.3-14.5