NEW YORK UNIVERSITY
ROBERT F. WAGNER GRADUATE SCHOOL OF PUBLIC SERVICE

Course Syllabus
Spring 2010
Statistical Methods for Public, Nonprofit, and Health Management

<table>
<thead>
<tr>
<th>LEC</th>
<th>INSTRUCTOR</th>
<th>TIME</th>
<th>LOCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>001</td>
<td>Professor Daniel L. Smith</td>
<td>Tue 6:45 – 8:40 PM</td>
<td>Rm 307 @ 194 Mercer St.</td>
</tr>
<tr>
<td>002</td>
<td>Professor Zhan Guo</td>
<td>Wed 6:45 – 8:40 PM</td>
<td>Rm 307 @ 194 Mercer St.</td>
</tr>
<tr>
<td>003</td>
<td>Professor Daniel L. Smith</td>
<td>Wed 12:45 – 2:40 PM</td>
<td>Rm 307 @ 194 Mercer St.</td>
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<td></td>
<td>004 Professor Caitlyn Brazill</td>
<td>Mon 6:45 – 8:25 PM</td>
<td>Rm 304 @ 194 Mercer St.</td>
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<td></td>
<td>005 Professor Judy Polyne</td>
<td>Mon 4:55 – 6:35 PM</td>
<td>Rm 304 @ 194 Mercer St.</td>
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<td></td>
<td>006 Professor Kevin Brabazon</td>
<td>Tue 8:35 – 10:15 PM</td>
<td>Tisch Hall LC19</td>
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<tr>
<td></td>
<td>007 Professor Kevin Brabazon</td>
<td>Fri 12:30 – 2:10 PM</td>
<td>Tisch Hall LC19</td>
</tr>
<tr>
<td></td>
<td>008 Professor Judy Polyne</td>
<td>Thu 6:45 – 8:25 PM</td>
<td>Rm 304 @ 194 Mercer St.</td>
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</tbody>
</table>

This course introduces students to basic statistical methods and their application to management, policy, and financial decision-making. The course covers the essential elements of descriptive statistics, univariate and bivariate statistical inference, and an introduction to multivariate analysis. In addition to covering statistical theory, the course emphasizes applied statistics and data analysis, using the software package SPSS.

The course has several “audiences” and goals. For all Wagner students, the course develops basic analytical skills and encourages a critical approach to reviewing statistical findings and using statistical reasoning in decision-making. For those planning to continue studying statistics (often those in policy and finance concentrations), this course additionally provides the foundation for that additional work.


**Other online/written material.** PowerPoint slides will be used during lectures throughout the course. Electronic copies of these are posted on the class Blackboard site, where they may be downloaded and printed. Printed copies of the week’s PowerPoint slides should be brought to each lecture.
Several other written print and online resources are available to assist you in mastering the material. Your instructor will provide numerous practice problems and answers, as well as copies of old exams and answers. In order to master the course material, you should plan to work (and rework!) all of the practice problems, the “challenge problems”, and old exams prior to taking the midterm and final.

**SPSS and the weekly lab sessions.** This is a course in applied statistics, with a lot of data analysis, both for homework and for the final analytical memo assignment. Some of these analyses will be done manually, with the help of a hand-held calculator. However, computers do this sort of work quickly and without error, making a software package such as SPSS indispensable. Most weeks, in addition to reading and homework based on the *Essentials* texts, you will also have reading and homework from *Wagner Way*.

Some of the SPSS procedures in *Wagner Way* will be discussed and demonstrated during lecture. Some students will find that reading *Wagner Way* prior to the lecture and then watching the demonstrations provides adequate support for learning SPSS. Those in need of additional assistance with SPSS must attend the weekly lab sessions. During those sessions, the instructor will demonstrate SPSS procedures, explain SPSS output, and generally reinforce and support use of the computer program.

During the weeks when there is no new SPSS material, the lab sessions will be devoted to review of material from the lecture portion of the course. Your lab instructor will tell you more about how s/he plans to run the sessions.

**Tutoring sessions.** Finally, two tutors will be available for weekly in-person meetings and discussion of homework problems (times and locations TBA on the Blackboard sites).

**Course objectives.** Students completing the course should gain the following knowledge and skills:

- An understanding of the different levels of measurement (nominal, ordinal and interval) and their relevance for different analytic techniques.
- An understanding of basic descriptive statistics including the mean, median, mode, range and standard deviation; and ability to calculate these statistics and to generate them using SPSS software; an understanding of when each may be appropriate for descriptive purposes.
- An ability to calculate confidence intervals for means and proportions and to assess the relative merits of point versus interval estimates for means and proportions.
- An understanding of the basic principles of statistical inference including the importance of sampling distributions and the standard error.
- An ability to determine appropriate tests of statistical significance for differences in means, differences in percentage distributions and cross-tabulations, and to execute that work manually and using SPSS software.
- An ability to determine when bivariate regression and correlation are appropriate analytic approaches, and to calculate and interpret regression and correlation coefficients, both manually and using SPSS software.
- An ability to design a multiple regression analysis, to generate regression results using SPSS software, and to interpret these results for statistical and theoretical significance.
**Requirements and Grades.** Course grades are based on the following:

- in-class mid-term exam (25%);
- analytical memo assignment (25%);
- in-class final exam (35%); and
- timely completion of assigned homework and contribution to class discussion (15%).

For the written exams, students will be permitted to use a basic calculator and an 8 ½-by-11-inch, single-sided, handwritten sheet of notes. The notes may not be electronically produced or reproduced (i.e., cut and paste). The calculator must have a square root key, but it may not be a graphing calculator, cell phone, PDA, laptop, or any other device that isn’t first and foremost a calculator.
Schedule

CLASS 1 – Introduction

1. What are statistics and how are they useful?
   • descriptive vs. inferential statistics
   • populations and samples
   • levels of measurement

2. How can information (data) be summarized: Basic Descriptive Statistics
   • percentages and proportions
   • ratios and rates
   • frequency distributions: one-way and two-way tables
   • graphs and figures

3. Computer demo: Getting started with SPSS

CLASS 2 – Central Tendency and Dispersion

1. Measures of Central Tendency
   • mode, median, percentiles, means; weighted means

2. Measures of Dispersion
   • range
   • average deviation
   • standard deviation
   • coefficient of variation

3. Computer demo: Univariate descriptive statistics with SPSS

CLASS 3 – The Normal Curve

1. The normal distribution
   • the normal curve
   • standard (z) scores
   • using the normal curve to estimate probabilities

2. Computer demo: Bivariate descriptive statistics with SPSS
1. How are samples selected?
   - drawing representative samples
   - simple random sampling and other sample techniques
   - sampling distributions

2. How do we infer from sample estimates?
   - sampling error - standard error of a sample statistic
   - the central limit theorem

3. Computer demo: Sampling Distribution applet

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1. What is a “good” estimator?
   - point estimates and confidence intervals
   - bias and efficiency

2. How do we construct a confidence interval when the population standard deviation is known?
   - confidence levels and alpha
   - interval estimates for means and proportions

3. Computer demo: Recoding variables in SPSS

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1. How do we make decisions about a population parameter based on one sample estimate?
   - null and research hypotheses
   - establishing the critical region; decision rules
   - one-tailed (< or >) and two-tailed (not =) tests
   - type I and type II error
   - means and proportions

2. How are interval estimates constructed and hypothesis tests conducted for small samples when the population standard deviation is unknown?
   - the $t$ distribution
CLASS 7 – Hypothesis Testing-II

1. How do we make decisions about population parameters based on two sample estimates?
   - difference of means - large and small samples
   - difference of proportions - large samples

CLASS 8 – MIDTERM EXAM

The midterm is an in-class exam that covers material through Class 6.

CLASS 9 – Analysis of variance

1. How can we test for a difference in means when our independent variable is categorical and has more than two categories?
   - the underlying concept of ANOVA
   - Sum of Squares Within and Sum of Squares Between
   - the F ratio
   - applying the five-step model of hypothesis testing to ANOVA
   - limitations to ANOVA and post hoc tests

2. Computer Demo: Hypothesis testing with means in SPSS

CLASS 10 – Bivariate tables, chi-square

1. How can we test if there is an association between two categorical variables (or, how do we make decisions about more than two population proportions based on sample estimates)?
   - bivariate tables
   - independent and dependent variables
   - expected and observed frequencies
   - the chi-square distribution and statistic
   - sample size considerations

2. Beyond Essentials: Joint and conditional probability

3. Computer demo: Chi square test in SPSS
1. How do we estimate the magnitude of the relationship between two continuous variables?
   • the concept of association, including pattern or direction
   • dependent and independent variables
   • use of scattergrams
   • the regression line and linear relationships
   • using least squares to compute estimates of the intercept and slope

CLASS 12 – Bivariate Regression and Correlation-2

1. How do we measure the strength of the association between two continuous variables?
   • coefficient of correlation (r)
   • coefficient of determination (R²)
   • explained and unexplained variation
   • test of significance for r
2. Computer demo: Bivariate regression and correlation in SPSS

CLASS 13 – Controlling for Other Variables

1. How do we control for the effects of a third variable?
   • direct relationships, spurious relationships, intervening variables
2. How do we estimate the magnitude of the relationship between one dependent variable and more than one independent variables?
   • multiple regression equation
   • coefficient of multiple determination

CLASS 14 – Controlling for Other Variables and Selected Topics

1. How can we use categorical data in the regression framework?
   • dummy coding of independent variables
2. Computer demo: dummy variables in SPSS
3. Discussion of final assignment
4. Violation of the underlying assumptions
   • Collinearity

CLASS 15 – In-class Final Exam

The final exam is given during the usual class time and in the usual class location. The dates are given on page 9.

The analytical memo is due Friday, April 30th at 12 noon, for all sections.
<table>
<thead>
<tr>
<th>CLASS</th>
<th>LECTURE TOPIC</th>
<th>READING IN Essentials</th>
<th>READING IN Wagner Way</th>
<th>IN CLASS COMPUTER DEMO</th>
<th>Homework to hand in during lecture?</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction</td>
<td>Ch. 1 - 3</td>
<td>Ch. 1</td>
<td>Introduction to SPSS</td>
<td>No</td>
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<tr>
<td>2</td>
<td>Central tendency and dispersion</td>
<td>Ch. 4 and 5</td>
<td>Ch. 2</td>
<td>Univariate descriptives in SPSS</td>
<td>Yes</td>
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<tr>
<td>3</td>
<td>Normal curve</td>
<td>Ch. 6</td>
<td>Ch.3</td>
<td>Bivariate descriptives in SPSS</td>
<td>Yes</td>
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<tr>
<td>4</td>
<td>Sampling &amp; sampling distribution</td>
<td>Ch. 7 (pp. 146-154)</td>
<td>(none in WW), but 3 documents on BB</td>
<td>Sampling distribution applet</td>
<td>Yes</td>
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<tr>
<td>5</td>
<td>Estimation</td>
<td>Ch. 7 (pp. 154-172)</td>
<td>Ch. 4</td>
<td>Recoding variables in SPSS</td>
<td>Yes</td>
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<td>6</td>
<td>Hypothesis testing I</td>
<td>Ch. 8</td>
<td>(none)</td>
<td>(none)</td>
<td>Yes</td>
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<tr>
<td>7</td>
<td>Hypothesis testing II</td>
<td>Ch. 9</td>
<td>(none)</td>
<td>(none)</td>
<td>Yes</td>
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<td>8</td>
<td>(Midterm exam)</td>
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<td>No</td>
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<td>9</td>
<td>Hypothesis testing III</td>
<td>Ch. 10</td>
<td>Ch.5</td>
<td>Hypothesis testing of means in SPSS</td>
<td>Yes</td>
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<td>10</td>
<td>Bivariate tables, chi-square</td>
<td>Ch. 11, Ch. 12 (pp.282-290)</td>
<td>Ch. 6</td>
<td>Chi Square in SPSS</td>
<td>Yes</td>
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<tr>
<td>11</td>
<td>Bivariate regression</td>
<td>Ch. 14 (pp. 330-339)</td>
<td>(none)</td>
<td>(none)</td>
<td>Yes</td>
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<tr>
<td>12</td>
<td>Bivariate correlation</td>
<td>Ch. 14 (pp. 339-351)</td>
<td>Ch. 7</td>
<td>Bivariate regression and correlation in SPSS</td>
<td>Yes</td>
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<tr>
<td>13</td>
<td>Multivariate regression</td>
<td>Ch. 15 (pp. 362-364)</td>
<td>Ch. 8</td>
<td>Multiple regression in SPSS</td>
<td>Yes</td>
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<tr>
<td>14</td>
<td>Multivariate analysis</td>
<td>(none)</td>
<td>Ch. 9</td>
<td>Dummy variables in SPSS</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Note that homework assignments are posted on Blackboard under “Assignments”. You will not hand in homework in Class 1. You will hand in homework beginning with Class 2; you will submit your homework to your lecture instructor.

Each section’s final exam is given during the usual class time and in the usual class location. The dates are given on page 9 below. The final analytical memo is due **Friday, April 30th at 12 noon**, for all sections.
Lectures
Lectures will meet on the following dates (room locations listed on first page); particularly important dates are in bold:

<table>
<thead>
<tr>
<th>Tuesdays (Smith)</th>
<th>Wednesdays (Smith)</th>
<th>Wednesdays (Guo)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6:45 – 8:40 p.m.</td>
<td>12:45 – 2:40 p.m.</td>
<td>6:45 – 8:40 p.m.</td>
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<tr>
<td>Jan 19 Class 1</td>
<td>Jan 20 Class 1</td>
<td>Jan 20 Class 1</td>
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<tr>
<td>Jan 26 Class 2</td>
<td>Jan 27 Class 2</td>
<td>Jan 27 Class 2</td>
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<tr>
<td>Feb 2 Class 3</td>
<td>Feb 3 Class 3</td>
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<tr>
<td>Feb 9 Class 4</td>
<td>Feb 10 Class 4</td>
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<td>Feb 16 Class 5</td>
<td>Feb 17 Class 5</td>
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<tr>
<td>Feb 23 Class 6</td>
<td>Feb 24 Class 6</td>
<td>Feb 24 Class 6</td>
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<tr>
<td>Mar 2 Class 7</td>
<td>Mar 3 Class 7</td>
<td>Mar 3 Class 7</td>
</tr>
<tr>
<td><strong>Mar 9</strong> Class 8: Midterm</td>
<td><strong>Mar 10</strong> Class 8: Midterm</td>
<td><strong>Mar 10</strong> Class 8: Midterm</td>
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<tr>
<td>Mar 16 Spring break!</td>
<td>Mar 17 Spring break!</td>
<td>Mar 17 Spring break!</td>
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<tr>
<td>Mar 23 Class 9</td>
<td>Mar 24 Class 9</td>
<td>Mar 24 Class 9</td>
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<td>Mar 30 Class 10</td>
<td>Mar 31 Class 10</td>
<td>Mar 31 Class 10</td>
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<tr>
<td>Apr 6 Class 11</td>
<td>Apr 7 Class 11</td>
<td>Apr 7 Class 11</td>
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<td>Apr 13 Class 12</td>
<td>Apr 14 Class 12</td>
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<td>Apr 20 Class 13</td>
<td>Apr 21 Class 13</td>
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<tr>
<td>Apr 27 Class 14</td>
<td>Apr 28 Class 14</td>
<td>Apr 28 Class 14</td>
</tr>
<tr>
<td><strong>May 4</strong> NO CLASS: Reading Day*</td>
<td><strong>May 5</strong> Class 15: Final Exam</td>
<td><strong>May 5</strong> Class 15: Final Exam</td>
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<tr>
<td><strong>May 11</strong> Class 15: Final Exam*</td>
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*The final exam for the Tuesday section may be rescheduled to Tuesday, May 4, 6:45-8:40 p.m. Students in that section should hold both dates on their calendars.