EPSY 8269: Matrix Algebra for Statistical Modeling

Spring 2009
Mondays, 5:00 – 7:40 PM
375 Peik Hall

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Office Hours: Mondays, 2:30-4:30 PM or by appointment

Class Website: www.edmeasurement.net/matrix

Text

Kaw, A. K. (2008). *Introduction to Matrix Algebra*. First Edition

Interactive Web Based Tools

Bogacki, P. (2000). *Linear algebra toolkit*.
Old Dominion University
http://www.math.odu.edu/~bogacki/lat/

Waner, S., & Costenoble, S. R. (1998). *Matrix Algebra Tool*.
Hofstra University
http://people.hofstra.edu/faculty/Stefan_Waner/RealWorld/fancymatrixalg.html

S.O.S. Mathematics: Matrix Algebra by Math Medics (1999)
http://www.sosmath.com/matrix/matrix.html

The Course:

Statistics in the behavioral sciences and education is a practice-oriented field that provides a set of tools for the summary and interpretation of quantitative and qualitative data. Our study of linear and matrix algebra is primarily to provide a foundation for the understanding and use of basic statistical techniques. We will discuss the matrix algebra behind many of the common techniques. Application is the focus; however, conceptual understanding of the problem solving process used in linear and matrix algebra will be emphasized.

This course will cover basic concepts of linear and matrix algebra, including examples and applications familiar to students in education and social science research, and also include more formal definitions. Topics will include an introduction to multivariate statistical models, systems of equations and representing systems of equations (e.g., regression models); vectors and vector operations with applications to statistics, matrices and matrix operations and applications to statistics; and procedures for solving systems of linear equations.

The class will also include computer lab work and will meet in a computer lab several times throughout the session. The focus of the computer lab sessions will be on employing the MATRIX command language available in SPSS. Weekly exercises will be provided to exemplify each topic and operation covered in the course. The course will also employ several interactive web sites designed to provide students with the opportunity to see the operations in an interactive environment with applications in common areas of social science research.

Primary Course Objectives:

Students will become familiar with basic notation, representations of systems of equations, and learn to manipulate vectors and matrices through investigating applications of the operations covered in the course. Students will also learn to use the MATRIX command language in SPSS that will allow them to compute statistics as they prefer employing formulas directly rather than using the "canned" formulas employed by SPSS pull-down menus. This will allow students to see directly how common statistics are computed and provide greater understanding of the requirements for computation and address complex computation issues (e.g., when factor analysis fails due to matrix dependency or matrices that cannot be inverted).

- conduct basic statistical analyses including descriptive statistics and the evaluation of bivariate relationships,
- employ matrix notation to represent multivariate systems of linear equations,
- compute statistical tests and evaluate multiple systems of equations,
- employ SPSS to compute matrix algebra problems and use matrix syntax to conduct common statistical tests, and
- solidify understanding of the mechanics of regression and regression diagnostics.

Requirements:

Students will be expected to read the materials assigned to engage in class discussions of vector and matrix notation, representation, and applications. Problem sets are provided for practice and to gain experience using the matrix algebra techniques covered during the course. Each week, assigned problems will be required for course credit. In total, assigned problems will be weighted to equal 40% of the total grade.

There will be six quizzes. Each quiz will contain brief computational items and short-answer items requiring explanation of key concepts. The total sum of quizzes will be weighted to equal 40% of the total grade. The problem sets assigned for homework are representative of the problems you will encounter on the quizzes.

There will also be computer lab activities assigned during the course. The total sum of labs will be weighted to equal 20% of the total grade.

We will take as much time as is necessary to complete understanding of the material before we move on. There is time during each session to allow for extended time on a topic. The material is cumulative to a certain extent so it is imperative that you keep up with the workload. You are encouraged to work with a partner, as long as this works for you, and to utilize office hours to complete your understanding of the material from the moment you begin to feel uncertain. It is during these moments of uncertainty that a great deal of learning can occur.

Evaluation (http://www1.umn.edu/usenate/u_senate/usenpol.html):

A - achievement that is outstanding relative to the level necessary to meet course requirements.

B - achievement that is significantly above the level necessary to meet course requirements.

C - achievement that meets the course requirements in every respect.

D - achievement that is worthy of credit even though it fails to meet fully the course requirements.

I - (incomplete) assigned at the discretion of the instructor when, due to extraordinary circumstances. Requires a written agreement between instructor and student.

Letter Grade	Percentage
A	95-100%
A-	90-94.99%
B+	85-89.99%
B	80-84.99%
B-	75-79.99%
C+	70-74.99%
C	65-69.99%
C-	60-64.99%

The Senate affirms the standard (first adopted by the University Senate on February 16, 1922, and reaffirmed subsequently) that one semester credit is to represent, for the average University of Minnesota undergraduate student, three hours of academic work per week (including lectures, laboratories, recitations, discussion groups, field work, study, and so on), or approximately 45 hours of work over the course of an enrollment period. Expectations of faculty and students will be made clear. It is expected that the academic work required of graduate and professional students will exceed three hours per credit per week or 45 hours per semester.

How to Access Your Grades
You may view your grades online at www.onestop.umn.edu.

Returning Papers, Exams, and Projects
Final projects may be returned via U.S. mail with a self-addressed stamped envelope, or may be picked up in the Educational Psychology Department office in the Education Sciences Building. Any papers/assignments not picked up by the end of the fourth week of the following semester will be discarded and no longer available.

University of Minnesota Policy on Scholastic Misconduct:

Scholastic misconduct is broadly defined as any act that violates the rights of another student in academic work or that involves misrepresentation of your own work.

Defined in the Student Conduct Code: Scholastic Dishonesty. Scholastic dishonesty means plagiarizing; cheating on assignments or examinations; engaging in unauthorized collaboration on academic work; taking, acquiring, or using test materials without faculty permission; submitting false or incomplete records of academic achievement; acting alone or in cooperation with another to falsify records or to obtain dishonestly grades, honors, awards, or professional endorsement; or altering, forging, or misusing a University academic record; or fabricating or falsifying of data, research procedures, or data analysis.

Instruction:

Each course meeting will include lecture on key points of the day's topic(s) and a period of questions and answers. Many of the sessions will include time to cover more general statistical issues, work through examples, and discuss applications. Several sessions will include small group work (e.g., time to review assigned problems and computer assignments). As the instructor, I assume the following responsibilities: to present material in a clear and contextualized format, to provide opportunity for students to pursue additional clarification in and out of class, to develop and employ fair and meaningful assessment activities, to use results of evaluation activities for instructional feedback and course planning, and to provide opportunities for recourse if students believe they have been unfairly evaluated.

Technology:

Technology is becoming increasingly important in education and we will pursue learning with the aid of technology in several ways. Students will be allowed to submit assignments electronically. Two online references (Terwilliger and Rodriguez) have been selected and three interactive sites are available for use during the course. A class website will also be available where all assignments will be posted and where additional online resources will be provided. Several class sessions will be held in a computer lab to conduct hands-on matrix algebra analyses using the MATRIX syntax command language of SPSS. Demonstrations will also be conducted using SPSS in class.

Diversity:

The College of Education and Human Development is committed to have every course contribute to our understanding of diversity, including but not limited to: age, creed, disability, ethnicity, gender, global perspectives, international background, language background, learning differences, marital status, multicultural perspectives, national origin, public assistance status, race, religion, sex, sexual orientation, and veteran status. Each of these characteristics plays a role in educational and psychological measurement and research. They are factors that contribute to individual and group differences -- they (may) affect the constructs we set out to measure and the way we interpret and report statistical results. These issues are not central to the main topics of this course; however, some may be addressed in this course as we consider the selection of statistical tools to understand the role of group differences in evaluating educational and psychological data.

It is the University Policy to provide, on a flexible and individualized basis, reasonable accommodations to students who have disabilities that may affect their ability to participate in course activities or to meet course requirements. Students with disabilities are encouraged to contact me when possible to discuss their individual needs for accommodations.

University of Minnesota Mission Statement

The University of Minnesota, founded in the belief that all people are enriched by understanding, is dedicated to the advancement of learning and the search for truth; to the sharing of this knowledge through education for a diverse community; and to the application of this knowledge to benefit the people of the state, the nation, and the world. The University's mission, carried out on multiple campuses and throughout the state, is threefold: (1) research and discovery, (2) teaching and learning, and (3) outreach and public service.

College of Education & Human Development Mission Statement

The mission of the College of Education and Human Development is to generate knowledge about teaching, learning, and human development, and to apply that knowledge to improve education for all individuals.

Department of Educational Psychology Mission Statement

The broad mission of the Department of Educational Psychology is to:

- create and disseminate new knowledge about successful educational practices.
- preserve the established and time honored practices of the past.
- promote the welfare and development of all students from all abilities and backgrounds.

Within this mission, the department's priorities are to:

- prepare graduate students to take leadership in research, teaching, professional practice, and service.
- train new and practicing teachers in the instructional applications of psychological theory.
- foster an appreciation of the role that educational psychology can play in solving educational problems.
- work with schools and individuals to help them achieve their goals.

Psychological Foundations of Education Program Mission Statement

To apply and generate knowledge of psychological processes and methodological procedures involved in learning and teaching for the betterment and improvement of humans in a wide range of situations.

2009 *Matrix Algebra for Statistical Modeling* Schedule

January 19	*No Class*	*Martin Luther King, Jr. Day*
January 26	Vector 1	Intro & Review Vectors
February 2	Vector 2, 3 Quiz V1	Vector Geometry Vector Variance, Covariance, & Correlation Using SPSS Matrix Language
February 9	Vector 4, Matrix 1 Quiz V2	Intro to Matrices Matrix Statistics
February 16	Matrix 2 Quiz V3	Linear Equations Matrix Characteristics Regression and Regression Diagnostics
February 23	*No Class*	
March 2	Matrix 3 Quiz M1	Linear Dependence & Rank Linear Equations
March 9	Matrix 4 Regression Lab	Solving Systems of Equations ANOVA Table Solving for SS in Regression
March 16	*No Class*	*Spring Break*
March 23	MV Regression Lab	Multivariate Regression More Regression Diagnostics
March 30	Multivariate 1 Quiz MV1	Normalizing Vectors Eigenvalues & Eigenvectors Positive Definiteness Status Multivariate Techniques
April 6	Final Assignment Eigen Value Lab Quiz MV2	Principal Components Design Models Transformations
April 13	No Class	AERA
April 20	Special Topics	Determined through Semester
April 27	Special Topics	
May 4	No Class	