

## PhD 1504 - Quantitative Analysis II

**INSTRUCTOR:** Mingfei Li

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**OFFICE HOUR:** Wednesday 1:30pm - 3: 30pm

(Other times by appointment)

**COURSE INFORMATION**

**MEETING DAYS/TIME:** Tuesday 1:30pm-4:30pm,

Friday 1:00pm to 4:00pm (online)

**MEETING LOCATION: AAC214**

**Course Description**

This is the second course of a two-course sequence in quantitative methods and will focus on multivariate statistical methods. Building on the material from Quantitative Analysis I, the course will study some of the most commonly used multivariate techniques. The course begins by extending the ANOVA model to ANCOVA and then to the multivariate equivalents MANOVA and MANCOVA. Then classical forms of cluster analysis, principal components and exploratory factor analysis follow. Confirmatory factor analysis will then be covered and the rest of the course will be devoted to the study of structural equations models.

Copies of all course materials including lecture notes, handouts, assignments, data sets and any supplemental material will be available on the course Blackboard site.

**Learning Objectives**

**Knowledge:** For each of the methodologies discussed, students should:

* Have a conceptual understanding of how each method works
* Recognize why the method is appropriate to a particular application
* Understand how to perform the analysis using appropriate software
* Be able to interpret the results in a research context.
* Understand general statistical principles well enough to enable learning additional techniques beyond those covered.

**Skills:** Students will be able to:

* Present quantitative research results convincingly and address reasonable criticisms of the methods used.
* Critically read published research articles which make use of the techniques covered.
* Demonstrate facility with a statistical software package in a research context
* Develop a written research description of a statistical analysis

**Perspectives:** Students will develop:

* An appreciation for the nature of variability and the role of statistical methods in determining relationships between factors and quantifying the amount of inherently random variation in a problem.
* A respect for the power of quantitative research as well as an understanding of the appropriate inferences that can be drawn from particular methods.

**COURSE MATERIALS**

Textbook:

*Multivariate Data Analysis,* seventh edition,by Hair, Black, Babin, Anderson, Prentice Hall, 2010.

**Software**: SPSS Standard Grad Pack 24, Amos, or SAS

SAS installation guide and learning guide available the website of the Math Department:

<https://www.bentley.edu/academics/departments/mathematical-sciences/software>

**GRADING/PERFORMANCE EVALUATION**

The projects will be graded with quality of presentation as a factor. The course grade will be determined as follows:

* Assignments -30%
* In-class discussion - 10%
* Quizzes -30%
* Project – 30%

Class discussion will be critical to developing a broader and deeper understanding of the material and quantitative business research in particular and will include discussion of readings of research articles which demonstrate that participants understand the use of the covered techniques in published work. Class discussion is what will make the course applicable as real life statistical applications are not always as straight forward as they may appear.

Final Project will give students a chance to integrate statistical analysis tools and concepts to apply to a practical problem. Both oral and written report will be required.

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**Academic Integrity**

The students of Bentley, in a spirit of mutual trust and fellowship, aware of the values of a true education and the challenges posed by the world, do here-by pledge to accept the responsibility for honorable conduct in all academic activities, to assist one another in maintaining and promoting personal integrity, to abide by the principles set forth in the Honor Code, and to follow the procedures and observe the policies set forth in the Academic Integrity System.

The Bentley Honor Code formally acknowledges the necessity for students to take responsibility for their own ethical behavior. Through this code, all students are expected to maintain academic integrity in their own work. In addition, students are expected to take responsible action when there is a reason to suspect academic dishonesty. Success of the code depends upon each student’s good will to care enough for other students to counsel them to abandon dishonesty for their own sake and that of the community. Thus, the Honor Code asks all students to share responsibility for maintaining the integrity of Bentley academics.

The written homework or take-home quiz(es) in this course is meant to be an individual exercise. Students will, naturally and appropriately, talk about the problems (this is encouraged) but the final write up **must be a student own work in its entirety.** This includes all calculations. If two students submit homework problems that have identical and highly unlikely calculation errors, this is evidence that the students did not work on the problem themselves. **If you ever have a question regarding whether your level of collaboration is appropriate, ask Prof. Li!** Establishing a solid ethical foundation is an important part of your Bentley education and will enhance the value of your degree.

Bentley’s policies about academic integrity and the Bentley Honor Code can be found at:

<http://www.bentley.edu/shandbook/integrity/>

<http://www.bentley.edu/shandbook/Integrity/The_Bentley_Honor_Code.cfm>

**Course Tentative Outline**

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| **Class (date)** | **Topics** | **Reading for this day** | **Assignments due this day** |
| 1  (1/16) | Review syllabus  Intro to multivariate statistical analysis  Review tests of means  MANOVA | Chapter 1 & 7 |  |
| 2  (1/19) | ANCOVA |  |  |
| 3  (1/23) | MANCOVA |  |  |
| 4  (1/26) | Cluster Analysis  Hierarchical cluster analysis | Chapter 9 | Assignment 1 |
| 5  (1/30) | Non-hierarchical cluster analysis |  |  |
| 6  (2/2) | Factor analysis  Principal components analysis | Chapter 3 |  |
| 7  (2/6) | Principal components analysis |  | Assignment 2 |
| 8  (2/9) | Exploratory factor analysis |  |  |
| 9  (2/13) | Quiz I  Confirmatory factor analysis | Chapter 12 & 13 |  |
| 10  (2/16)  Today’s class is **from** **3pm to 6pm** | Confirmatory factor analysis |  |  |
| 11  (2/20) | Structural equation modeling | Chapter 14 & 15 | Assignment 3 |
| 12  (2/23) | Structural equation modeling |  |  |
| 13  (2/27) | Structural equation modeling |  | Quiz 2 due |
| 14  (3/2) | Structural equation modeling  Partial least squares (optional)  **Project Presentation** |  |  |
| 15  (3/13) | **Project presentation** |  |  |