Contact Name: Robert Mignone    Email: migner@cofc.edu    Phone: 3-5740

Department Name: Mathematics    Graduate Program name: Master of Science in Mathematics

Course Prefix, Number, and Title: MATH 540 Statistical Learning I

I. CATEGORY OF REVIEW (Check all that apply)

NEW COURSE  CHANGE COURSE  DELETE COURSE

----- (Complete all sections below that apply including those indicated) -----

X New Course ☐ Change Number (IV, VII, VIII, IX) ☐ Delete Course (IV, VII, IX)
(attach syllabus*)  ☐ Change Title (IV, VII, VIII, IX)
  ☐ Change Credits/Contact hours (II, IV, VII, IX)
  ☐ Prerequisite Change (IV, VII, VIII, IX)
  ☐ Edit Description (III, IV, VII, VIII, IX)

X Approve for Cross-listing (attach Graduate Permission to Cross-list Form)

Date (Semester/Year) the course will first be offered, course changes or deletion will go into effect: FALL 2013

NEW COURSE:

*ATTACH THE SYLLABUS FOR A NEW GRADUATE COURSE to include:

- Course description and objectives
- Method of teaching (e.g., lecture, seminar, on-line, hybrid)
- Required and optional texts and materials
- Graduate School Grading Scale
- Assignments, student learning outcomes and assessment components
- Policies to include attendance, Honor Code, American Disabilities Act statement
- Tentative course schedule with specific topics
List prerequisites and/or other restrictions below

Math 203, Math 220 and Math 350

Permission of Instructor

[Sign]

Will this course be added to the Degree Requirements?

a) ☐ Yes  X No

b) If yes, explain

II. NUMBER OF CREDITS and CONTACT HOURS per week

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Lab</th>
<th>Seminar</th>
<th>Ind. Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Contact Hours</td>
<td>3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

B. Credit Hours 3

Is this course repeatable? ☐ yes  X no  If so, how many credit hours may the student earn in this course?

III. CATALOG DESCRIPTION Limit to 50 words EXACTLY as you want it to appear in the catalog; include prerequisites, co-requisites, and other restrictions. If changing course description, please include both old and new course descriptions.

Introduction to various approaches to statistical learning including empirical processes, classification and clustering, nonparametric density estimation and regression, model selection and adaptive procedures, bootstrapping and cross-validation.
IV. RATIONALE / JUSTIFICATION: If course change – please indicate the course change details. If course change or deletion—please provide reasons for change(s) to or deletion of a course. If a new course—briefly address the goals/objectives for the course and the relationship to the strategic plan.

Vast amounts of data are being generated every day. It is the job of statisticians to make sense of it all by extracting important patterns and trends in an attempt to understand what the data says. Statistical learning emerged as part of the revolution in statistical science in response to the explosion in the amount of generated data. Put simply statistical learning studies ways to learn from data, and is part of the broader revolution of data enabled mathematics that compliments the revolution in other disciplines, such as computer science and engineering. It is critical that we train tomorrow’s STEM professionals in the theory and practice of statistical learning and this course will do at the graduate level what is being done at the undergraduate level through Math 440 Statistical Learning I. Graduate students taking Math 540 Statistical Learning I.

Many of the goals in the College of Charleston Strategic Plan involve science and, directly and indirectly, mathematics: Goal 1 describes the objective of providing students a highly personalized education based on the liberal arts (which has always included mathematics) and sciences core; Goal 2 focuses on developing or enhancing recognized undergraduate, graduate, and professional programs in areas that take advantage of our history, culture and location (including marine biology and environmental studies); and Goal 3 seeks to provide students with the global, and interdisciplinary perspectives necessary to address the social, economic, environmental, ethical, scientific and political issues of the 21st century.

Science, social science, economics, environmental sciences and political science are increasingly quantitative, computational, and theoretical disciplines, highly dependent upon the mathematical sciences for their practice and development, and those who study these disciplines now must be ever more mathematically capable. Statistical Learning I provides theoretical and practical exposure in support of quantitative/statistical analysis and ways to learn from data. Math 540 will increase the graduate statistics courses available for graduate students in the mathematics, environmental studies and other quantitative graduate programs.

V. STUDENT LEARNING OUTCOMES and ASSESSMENT
<table>
<thead>
<tr>
<th>Student Learning Outcomes</th>
<th>Assessment Method and Performance Expected</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>What will students know and be able to do when they complete the course?</strong></td>
<td></td>
</tr>
<tr>
<td><strong>1. Using statistical methods, students model phenomena in mathematical terms.</strong></td>
<td>The instructor will assess learning outcome 1 through projects, homework, midterm exam, and final exam for all graduate students in the class. The expectation is that 80% of the graduate students perform at a satisfactory level.</td>
</tr>
<tr>
<td><strong>2. Using statistical methods, students derive correct answers to challenging questions by applying the models from Learning Outcome 1.</strong></td>
<td>The instructor will assess learning outcome 1 through projects, homework, midterm exam, and final exam for all graduate students in the class. The expectation is that 80% of the graduate students perform at a satisfactory level.</td>
</tr>
<tr>
<td><strong>3. Students write complete, grammatically and logically correct arguments to prove their conclusions.</strong></td>
<td>The instructor will assess learning outcome 1 through projects, homework, midterm exam, and final exam for all graduate students in the class. The expectation is that 80% of the graduate students perform at a satisfactory level.</td>
</tr>
<tr>
<td><strong>4. Students learn the various approaches to statistical learning.</strong></td>
<td>The instructor will assess learning outcome 1 through projects, homework, midterm exam, and final exam for all graduate students in the class. The expectation is that 80% of the graduate students perform at a satisfactory level.</td>
</tr>
</tbody>
</table>

How does this course align with the student learning outcomes articulated for the major, program, or general education? What program-level outcome or outcomes does it support? Is the content or skill introduced, reinforced, or demonstrated in this course?

The first three learning outcomes are the mathematics program learning outcomes.
VII. IMPACT ON EXISTING PROGRAMS and COURSES: Please briefly document the impact and expected changes of this new/changed/deleted course on other departments, programs and courses; if deleting a course—list all departments and programs that include the course; if adding/changing a course—explain any overlap with existing courses in the same or different departments; if adding or deleting a course that will be part of a joint program identify the partner institution.

None are anticipated, since we have been offering Statistical Learning I as a graduate topics course co-listed with Math 440 for the past two years and other than enrollments being more acceptable, there has not been a noticeable impact on anything else.

VIII. COSTS ASSOCIATED WITH THE ACTION REQUESTED: List all of the new costs or cost savings, (including new faculty/staff requests, library or equipment, etc.) associated with the action requested. New courses requiring additional resources will need special justification.

None, since we already offer Math 440 and Math 540 would be co-listed.
IX. APPROVAL AND SIGNATURES

Signature of Program Director:  
Date: 2/4/2013

Signature of Department Chair:  
Date: 2/4/2013

Signature of Additional Chair*:  
Date: 

Signature of Schools' Dean:  
Date: 2/7/13

Signature of Additional Schools' Dean*:  
Date: 

Signature of the Provost:  
Date: 2/15/13

Signature of Budget Director/Business Affairs Office:  
Date: 

*For interdisciplinary courses

Return form to the Graduate School Office for Further Processing

Signature of Chair of the Faculty Committee on Graduate Education, Continuing Education & Special Programs:  
Date: 3/28/2013

Signature of Chair of the Graduate Council:  
Date: 3/18/13

Signature of Faculty Senate Secretary:  
Date: 

Date Approved by Faculty Senate: ________________________________
STATISTICAL LEARNING I
MATH 540
FALL 2012

Instructor: James E. Young, Ph.D.
Office: RSS 323
Phone: 953-7295
E-mail: youngj@cofc.edu
Office Hours: Tue and Thu: 10:45 – 12:15


Method of Teaching: Lecturing including active learning.

Grading:

Homework (due biweekly) (25%)
Projects (due December 10) (25%)
Midterm (due October 11) (25%)
Final Exam (due December 7) (25%)

Grade Scale:
A 90 – 100  B+  85 – 89  B  80 – 84  C+  75 – 79
C  70 – 74  D  60 – 69  F  0 – 59

Course Objectives: Students will learn the various approaches to statistical learning.

Learning Outcomes

1. Students learn the various approaches to statistical learning.

2. Using statistical methods, students model phenomena in mathematical terms.

3. Using statistical methods, students derive correct answers to challenging questions by applying the models from Learning Outcome 1.

4. Students write complete, grammatically and logically correct arguments to prove their conclusions.

Note: The learning objectives for Math 540 and Math 440 are the same, but the expectations for the graduate course will be higher. Typically there will be extra exam questions and additional projects appropriate for graduate level work. The course objectives and learning outcomes will be the same for Math 440 and Math 540, with a higher level of performance expected for graduate students, especially for learning outcome 4 Students write complete, grammatically and logically correct arguments to prove their conclusions. Graduate students will be expected to perform at an appropriate level.
# STATISTICAL LEARNING I (MATH 540)
## COURSE OUTLINE

<table>
<thead>
<tr>
<th>Date</th>
<th>Topics</th>
<th>Text Chapters</th>
</tr>
</thead>
<tbody>
<tr>
<td>8/21</td>
<td>Introduction, background, and motivation</td>
<td>1</td>
</tr>
<tr>
<td>8/23</td>
<td>Statistical learning paradigm</td>
<td>2.1-2.2</td>
</tr>
<tr>
<td>8/28</td>
<td>Empirical risk minimization (ERM) induction</td>
<td>2.3-2.4;2.6-2.7;2.9;notes</td>
</tr>
<tr>
<td>8/30</td>
<td>Consistency of ERM induction</td>
<td>notes</td>
</tr>
<tr>
<td>9/4</td>
<td>Uniform one-sided convergence characterization of the consistency of ERM induction</td>
<td>7.9; notes</td>
</tr>
<tr>
<td>9/6</td>
<td>Vapnik-Chervonenkis (VC) entropy for family of indicators</td>
<td>notes</td>
</tr>
<tr>
<td>9/11</td>
<td>Uniform convergence of frequencies to their probabilities</td>
<td>notes</td>
</tr>
<tr>
<td>9/13</td>
<td>VC entropy for a family of real-valued functions</td>
<td>7.9; notes</td>
</tr>
<tr>
<td>9/18</td>
<td>Uniform convergence of sample means to their expectations</td>
<td>notes</td>
</tr>
<tr>
<td>9/20</td>
<td>Popper nonfalsifiability applied to statistical learning</td>
<td>notes</td>
</tr>
<tr>
<td>9/25</td>
<td>Guest lecture</td>
<td></td>
</tr>
<tr>
<td>9/27</td>
<td>Exponential rate of convergence for ERM induction for classification: finite family</td>
<td>notes</td>
</tr>
<tr>
<td>10/2</td>
<td>Exponential rate of convergence for ERM induction for classification</td>
<td>notes</td>
</tr>
<tr>
<td>10/4</td>
<td>Growth of growth function and VC dimension of family of indicators</td>
<td>7.9; notes</td>
</tr>
<tr>
<td></td>
<td><strong>Begin MIDTERM</strong></td>
<td></td>
</tr>
<tr>
<td>10/9</td>
<td>Constructive distribution-free exponential bounds on generalization ability (capacity) of learners for classification</td>
<td>notes</td>
</tr>
<tr>
<td>10/11</td>
<td>Exponential rate of convergence for ERM induction for regression: finite case</td>
<td>notes</td>
</tr>
<tr>
<td></td>
<td><strong>MIDTERM due</strong></td>
<td></td>
</tr>
<tr>
<td>10/16</td>
<td>Exponential rate of convergence for ERM induction for regression: universally bounded nonnegative case</td>
<td>notes</td>
</tr>
<tr>
<td>10/18</td>
<td>Exponential rate of convergence for ERM induction for regression: nonnegative case</td>
<td>notes</td>
</tr>
<tr>
<td>10/23</td>
<td>Structural risk minimization (SRM) induction</td>
<td>7.9; notes</td>
</tr>
<tr>
<td>10/25</td>
<td>Consistency of SRM induction</td>
<td>7.9; notes</td>
</tr>
<tr>
<td>10/30</td>
<td>Asymptotic rate of convergence for SRM induction</td>
<td>notes</td>
</tr>
<tr>
<td>11/1</td>
<td>Application of SRM induction to normal mixture models</td>
<td>notes</td>
</tr>
<tr>
<td>11/8</td>
<td>Application of SRM induction to linear basis expansion regression</td>
<td>2.8; 5; notes</td>
</tr>
<tr>
<td>11/13</td>
<td>Local risk minimization (LRM) induction</td>
<td>notes</td>
</tr>
<tr>
<td>11/15</td>
<td>Application of LRM induction to local kernel smoothing regression</td>
<td>2.8; 6; notes</td>
</tr>
<tr>
<td>11/20</td>
<td>Upper bounds for LRM induction</td>
<td>notes</td>
</tr>
<tr>
<td>11/27</td>
<td>Ill-posed problems and method of regularization</td>
<td>2.8;5.8; notes</td>
</tr>
<tr>
<td>11/29</td>
<td>Stochastic ill-posed problems</td>
<td>2.8; 5.8; notes</td>
</tr>
<tr>
<td></td>
<td><strong>Begin FINAL EXAM</strong></td>
<td></td>
</tr>
<tr>
<td>12/7</td>
<td><strong>FINAL EXAM due</strong></td>
<td></td>
</tr>
<tr>
<td>12/10</td>
<td><strong>PROJECT due</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Note:** This schedule is meant as a guide. Some sections or subsections may be omitted depending on availability of time and/or superceding priorities. Any deviations from this schedule will be announced in advance.
Class attendance policy: Every student is expected to attend every class. If extreme circumstances necessitate an absence, get the notes and assignment from a classmate or see me. You are responsible for making up any missed work. Four or more absences from the class will result in a grade of WA (See p. 18 of the Undergraduate Catalog for more information). I encourage you to see me with any problems you may have, either during my office hours, or make an appointment to see me at another time if your work schedule conflicts.

Honor Code and Academic Integrity: (language provided by the Dean of Students)

Lying, cheating, attempted cheating, and plagiarism are violations of our Honor Code that, when identified, are investigated. Each instance is examined to determine the degree of deception involved.

Incidents where the professor believes the student’s actions are clearly related more to ignorance, miscommunication, or uncertainty, can be addressed by consultation with the student. We will craft a written resolution designed to help prevent the student from repeating the error in the future. The resolution, submitted by form and signed by both the professor and the student, is forwarded to the Dean of Students and remains on file.

Cases of suspected academic dishonesty will be reported directly to the Dean of Students. A student found responsible for academic dishonesty will receive a XF in the course, indicating failure of the course due to academic dishonesty. This grade will appear on the student’s transcript for two years after which the student may petition for the X to be expunged. The student may also be placed on disciplinary probation, suspended (temporary removal) or expelled (permanent removal) from the College by the Honor Board.

It is important for students to remember that unauthorized collaboration—working together without permission—is a form of cheating. Unless a professor specifies that students can work together on an assignment and/or test, no collaboration is permitted. Other forms of cheating include possessing or using an unauthorized study aid (such as a PDA), copying from another’s exam, fabricating data, and giving unauthorized assistance.

Remember, research conducted and/or papers written for other classes cannot be used in whole or in part for any assignment in this class without obtaining prior permission from the professor.

Students can find a complete version of the Honor Code and all related processes in the Student Handbook.

Students with Disabilities
If you have a learning disability that will affect your performance in this class, you should contact Disability Services (953-1431) and talk to me in private. I can make no special testing allowances without documentation from Disability Services. Appointments with Disability Services for alternate testing must be made by the student at least three days in advance of the test.
GRADUATE PERMISSION TO CROSS-LIST FORM

This form must ALWAYS be accompanied by a graduate COURSE FORM.

Contact Name: Robert Mignone     Email: mignoner@cofc.edu     Phone: 5740

Department and School Name: Mathematics in SSM     Name and Acronym of Graduate Program: Master of Science in Mathematics

Date (Semester/Year) cross-listing will take effect: Fall 2013

I. CATEGORY OF REVIEW (Check all that apply)

☐ New Course -- Course Number/Title MATH 540 Statistical Learning I
☐ Existing Course -- Course Number/Title
☐ Special Topic Course -- Course Number/Title

This course will be cross-listed with an

☐ undergraduate course (complete sections II, III, and IV below) MATH 440
☐ existing graduate course (complete section IV below)

II. CURRICULUM DIFFERENCES –UNDERGRADUATE AND GRADUATE LEVELS

Please submit separate syllabi for both graduate and undergraduate courses

Syllabi for both undergraduate and graduate courses are attached     ☑ YES     ☐ NO

Explain the differences between the syllabi in terms of requirements, learning objectives and course content

The learning objectives are the same, but the expectations for the graduate course will be higher. Typically there will be extra exam questions and additional projects appropriate for graduate level work. The course objectives and learning outcomes will be the same for Math 440 and Math 540, with a higher level of performance expected for graduate students, especially for learning outcome 3 Students write complete, grammatically and logically correct arguments to prove their conclusions. Graduate students will be expected to perform at an appropriate level.
III. APPROVAL SECTION – GRADUATE COURSE WITH UNDERGRADUATE COURSE

Undergraduate Course Number / Title  MATH 441 Statistical Learning II

Names and Signatures:
Name of Department Chair of the Graduate Course  Robert Mignone
Signature  ___________________________ Date:  2/4/2013

Department Chair of the Undergraduate Course  Robert Mignone
Signature  ___________________________ Date:  2/4/2013

Graduate Program Director  Ben Cox
Signature  ___________________________ Date:  2/4/2013

Dean  Michael Atterbach
Signature  ___________________________ Date:  2/7/13

Provost  George Hynd
Signature  ___________________________ Date:  2/15/13

IV. APPROVAL SECTION – GRADUATE COURSE WITH EXISTING GRADUATE COURSE

Graduate Course Number / Title of Existing Graduate Course

Program(s) of Existing Graduate Course

Names and Signatures:
“Host” Program Director
Signature  ___________________________ Date:  

“Requesting” Program Director
Signature  ___________________________ Date:  

Provost
Signature  ___________________________ Date:  

September 2011
Return form to the Graduate School Office for Further Processing

Signature of Chair of the Faculty Committee on Graduate Education, Continuing Education & Special Programs:

__________________________ Date: 2/28/2013

Signature of Chair of the Graduate Council:

__________________________ Date: ______________

Signature of Faculty Senate Secretary:

__________________________ Date: ______________

Date Approved by Faculty Senate: ____________________________
STATISTICAL LEARNING I
MATH 440
FALL 20xx

Instructor: James E. Young, Ph.D.

Office: RSS 323

Phone: 953-7295

E-mail: youngj@cofc.edu

Office Hours: Tue and Thu: 10:45 – 12:15


Method of Teaching: Lecturing including active learning.

Grading:

Homework (due biweekly) (25%)

Project (due December 10) (25%)

Midterm (due October 11) (25%)

Final Exam (due December 7) (25%)

Grading Scale
A is 90 or above; A- is 87 to 89; B+ is 84 to 86; B is 80 to 83; B- is 77 to 79; C+ is 74 to 76; C is 70 to 73; C- is 67 to 69; D+ is 64 to 66; D is 60 to 63; D- is 59; F is 58 and below.

Course Objectives: Students will learn the various approaches to statistical learning.

Learning Outcomes

1. Students learn the various approaches to statistical learning.

2. Using statistical methods, students model phenomena in mathematical terms.

3. Using statistical methods, students derive correct answers to challenging questions by applying the models from Learning Outcome 1.

4. Students write complete, grammatically and logically correct arguments to prove their conclusions.
<table>
<thead>
<tr>
<th>Date</th>
<th>Topics</th>
<th>Text Chapters</th>
</tr>
</thead>
<tbody>
<tr>
<td>8/21</td>
<td>Introduction, background, and motivation</td>
<td>1</td>
</tr>
<tr>
<td>8/23</td>
<td>Statistical learning paradigm</td>
<td>2.1-2.2</td>
</tr>
<tr>
<td>8/28</td>
<td>Empirical risk minimization (ERM) induction</td>
<td>2.3-2.4;2.6-2.7;2.9; notes</td>
</tr>
<tr>
<td>8/30</td>
<td>Consistency of ERM induction</td>
<td>notes</td>
</tr>
<tr>
<td>9/4</td>
<td>Uniform one-sided convergence characterization of the consistency of ERM induction</td>
<td>7.9 notes</td>
</tr>
<tr>
<td>9/6</td>
<td>Vapnik-Chervonenkis (VC) entropy for family of indicators</td>
<td>notes</td>
</tr>
<tr>
<td>9/11</td>
<td>Uniform convergence of frequencies to their probabilities</td>
<td>notes</td>
</tr>
<tr>
<td>9/13</td>
<td>VC entropy for a family of real-valued functions</td>
<td>7.9; notes</td>
</tr>
<tr>
<td>9/18</td>
<td>Uniform convergence of sample means to their expectations</td>
<td>notes</td>
</tr>
<tr>
<td>9/20</td>
<td>Popper nonfalsifiability applied to statistical learning</td>
<td>notes</td>
</tr>
<tr>
<td>9/25</td>
<td>Guest lecture</td>
<td></td>
</tr>
<tr>
<td>9/27</td>
<td>Exponential rate of convergence for ERM induction for classification: finite family</td>
<td>notes</td>
</tr>
<tr>
<td>10/2</td>
<td>Exponential rate of convergence for ERM induction for classification</td>
<td>notes</td>
</tr>
<tr>
<td>10/4</td>
<td>Growth of growth function and VC dimension of family of indicators</td>
<td>7.9; notes</td>
</tr>
<tr>
<td></td>
<td><strong>Begin MIDTERM</strong></td>
<td></td>
</tr>
<tr>
<td>10/9</td>
<td>Constructive distribution-free exponential bounds on generalization ability (capacity) of learners for classification</td>
<td>notes</td>
</tr>
<tr>
<td>10/11</td>
<td>Exponential rate of convergence for ERM induction for regression: finite case</td>
<td>notes</td>
</tr>
<tr>
<td></td>
<td><strong>MIDTERM due</strong></td>
<td></td>
</tr>
<tr>
<td>10/16</td>
<td>Exponential rate of convergence for ERM induction for regression: universally bounded nonnegative case</td>
<td>notes</td>
</tr>
<tr>
<td>10/18</td>
<td>Exponential rate of convergence for ERM induction for regression: nonnegative case</td>
<td>notes</td>
</tr>
<tr>
<td>10/23</td>
<td>Structural risk minimization (SRM) induction</td>
<td>7.9; notes</td>
</tr>
<tr>
<td>10/25</td>
<td>Consistency of SRM induction</td>
<td>7.9; notes</td>
</tr>
<tr>
<td>10/30</td>
<td>Asymptotic rate of convergence for SRM induction</td>
<td>notes</td>
</tr>
<tr>
<td>11/1</td>
<td>Application of SRM induction to normal mixture models</td>
<td>notes</td>
</tr>
<tr>
<td>11/8</td>
<td>Application of SRM induction to linear basis expansion regression</td>
<td>2.8; 5; notes</td>
</tr>
<tr>
<td>11/13</td>
<td>Local risk minimization (LRM) induction</td>
<td>notes</td>
</tr>
<tr>
<td>11/15</td>
<td>Application of LRM induction to local kernel smoothing regression</td>
<td>2.8; 6; notes</td>
</tr>
<tr>
<td>11/20</td>
<td>Upper bounds for LRM induction</td>
<td>notes</td>
</tr>
<tr>
<td>11/27</td>
<td>Ill-posed problems and method of regularization</td>
<td>2.8; 5.8; notes</td>
</tr>
<tr>
<td>11/29</td>
<td>Stochastic ill-posed problems</td>
<td>2.8; 5.8; notes</td>
</tr>
<tr>
<td></td>
<td><strong>Begin FINAL EXAM</strong></td>
<td></td>
</tr>
<tr>
<td>12/7</td>
<td><strong>FINAL EXAM due</strong></td>
<td></td>
</tr>
<tr>
<td>12/10</td>
<td><strong>PROJECT due</strong></td>
<td></td>
</tr>
</tbody>
</table>
Note: This schedule is meant as a guide. Some sections or subsections may be omitted depending on availability of time and/or superceding priorities. Any deviations from this schedule will be announced in advance.

**Class attendance policy:** Every student is expected to attend every class. If extreme circumstances necessitate an absence, get the notes and assignment from a classmate or see me. You are responsible for making up any missed work. Four or more absences from the class will result in a grade of WA (See p. 18 of the Undergraduate Catalog for more information). I encourage you to see me with any problems you may have, either during my office hours, or make an appointment to see me at another time if your work schedule conflicts.

**Honor Code and Academic Integrity:** (language provided by the Dean of Students)

*Lying, cheating, attempted cheating, and plagiarism are violations of our Honor Code that, when identified, are investigated. Each instance is examined to determine the degree of deception involved.*

*Incidents where the professor believes the student’s actions are clearly related more to ignorance, miscommunication, or uncertainty, can be addressed by consultation with the student. We will craft a written resolution designed to help prevent the student from repeating the error in the future. The resolution, submitted by form and signed by both the professor and the student, is forwarded to the Dean of Students and remains on file.*

*Cases of suspected academic dishonesty will be reported directly to the Dean of Students. A student found responsible for academic dishonesty will receive a XF in the course, indicating failure of the course due to academic dishonesty. This grade will appear on the student’s transcript for two years after which the student may petition for the X to be expunged. The student may also be placed on disciplinary probation, suspended (temporary removal) or expelled (permanent removal) from the College by the Honor Board.*

*It is important for students to remember that unauthorized collaboration—working together without permission— is a form of cheating. Unless a professor specifies that students can work together on an assignment and/or test, no collaboration is permitted. Other forms of cheating include possessing or using an unauthorized study aid (such as a PDA), copying from another’s exam, fabricating data, and giving unauthorized assistance.*

*Remember, research conducted and/or papers written for other classes cannot be used in whole or in part for any assignment in this class without obtaining prior permission from the professor.*

*Students can find a complete version of the Honor Code and all related processes in the Student Handbook.*

**Students with Disabilities**

If you have a learning disability that will affect your performance in this class, you should contact Disability Services (953-1431) and talk to me in private. I can make no special testing allowances without documentation from Disability Services. Appointments with Disability Services for alternate testing must be made by the student at least three days in advance of the test.
Contact Name: Robert Mignone   Email: mignonem@cofc.edu   Phone: 3-5740
Department Name: Mathematics   Graduate Program name: Master of Science in Mathematics
Course Prefix, Number, and Title: MATH 541 Statistical Learning II

I. CATEGORY OF REVIEW (Check all that apply)

NEW COURSE   CHANGE COURSE   DELETE COURSE

----- (Complete all sections below that apply including those indicated) -----

X New Course □ Change Number (IV, VII, VIII, IX) □ Delete Course (IV, VII, IX)
(attach syllabus*) □ Change Title (IV, VII, VIII, IX)
□ Change Credits/Contact hours (II, IV, VII, IX)
□ Prerequisite Change (IV, VII, VIII, IX)
□ Edit Description (III, IV, VII, VIII, IX)

X Approve for Cross-listing (attach Graduate Permission to Cross-list Form)

Date (Semester/Year) the course will first be offered, course changes or deletion will go into effect: Spring 2014

NEW COURSE:

*ATTACH THE SYLLABUS FOR A NEW GRADUATE COURSE to include:

• Course description and objectives
• Method of teaching (e.g., lecture, seminar, on-line, hybrid)
• Required and optional texts and materials
• Graduate School Grading Scale
• Assignments, student learning outcomes and assessment components
• Policies to include attendance, Honor Code, American Disabilities Act statement
• Tentative course schedule with specific topics
List prerequisites and/or other restrictions below

Math 540

Will this course be added to the Degree Requirements?

a) ☐ Yes  X No

b) If yes, explain

II. NUMBER OF CREDITS and CONTACT HOURS per week

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Lab</th>
<th>Seminar</th>
<th>Ind. Study</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A. Contact Hours 3

B. Credit Hours 3

Is this course repeatable? ☐ yes  X no  If so, how many credit hours may the student earn in this course?

III. CATALOG DESCRIPTION Limit to 50 words EXACTLY as you want it to appear in the catalog: include prerequisites, co-requisites, and other restrictions. If changing course description, please include both old and new course descriptions.

Neural networks, nearest neighbor procedures, Vapnik Chervonenkis dimension, support vector machines, structural risk minimization induction, regularization methods and boosting, and baggin in classification and regression.
IV. RATIONALE / JUSTIFICATION: If course change – please indicate the course change details. If course change or deletion—please provide reasons for change(s) to or deletion of a course. If a new course—briefly address the goals/objectives for the course and the relationship to the strategic plan.

Vast amounts of data are being generated every day. It is the job of statisticians to make sense of it all by extracting important patterns and trends in an attempt to understand what the data says. Statistical learning emerged as part of the revolution in statistical science in response to the explosion in the amount of generated data. Put simply statistical learning studies ways to learn from data and is part of the broader revolution of data enabled mathematics that compliments the revolution in other disciplines, such as computer science and engineering. It is critical that we train tomorrows STEM professionals in the theory and practice of statistical learning and this course will do at the graduate level, as a continuation of Math 540, what is being done at the undergraduate level through Math 441, as a continuation of Math 440. Statistical Learning II. Graduate students taking Math 541 Statistical Learning I will have higher expectations in terms of additional projects and performance than undergraduates in the same class taking Math 441.

Many of the goals in the College of Charleston Strategic Plan involve science and, directly and indirectly, mathematics: Goal 1 describes the objective of providing students a highly personalized education based on the liberal arts (which has always included mathematics) and sciences core; Goal 2 focuses on developing or enhancing recognized undergraduate, graduate, and professional programs in areas that take advantage of our history, culture and location (including marine biology and environmental studies); and Goal 3 seeks to provide students with the global, and interdisciplinary perspectives necessary to address the social, economic, environmental, ethical, scientific and political issues of the 21st century.

Science, social science, economics, environmental sciences and political science are increasingly quantitative, computational, and theoretical disciplines, highly dependent upon the mathematical sciences for their practice and development, and those who study these disciplines now must be ever more mathematically capable. Statistical Learning I provides theoretical and practical exposure in support of quantitative/statistical analysis and ways to learn from data. Math 541 will increase the graduate statistics courses available for graduate students in the mathematics, environmental studies and other quantitative graduate programs.
## V. STUDENT LEARNING OUTCOMES and ASSESSMENT

<table>
<thead>
<tr>
<th>Student Learning Outcomes</th>
<th>Assessment Method and Performance Expected</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>What will students know and be able to do when they complete the course?</strong></td>
<td><strong>How will each outcome be measured? Who will be assessed, when, and how often? How well should students be able to do on the assessment?</strong></td>
</tr>
<tr>
<td>1. Using statistical methods, students model phenomena in mathematical terms.</td>
<td>The instructor will assess learning outcome 1 through projects, homework, midterm exam, and final exam for all graduate students in the class. The expectation is that 80% of the graduate students perform at a satisfactory level.</td>
</tr>
<tr>
<td>2. Using statistical methods, students derive correct answers to challenging questions by applying the models from Learning Outcome 1.</td>
<td></td>
</tr>
<tr>
<td>3. Students write complete, grammatically and logically correct arguments to prove their conclusions.</td>
<td>The instructor will assess learning outcome 1 through projects, homework, midterm exam, and final exam for all graduate students in the class. The expectation is that 80% of the graduate students perform at a satisfactory level.</td>
</tr>
<tr>
<td>4. Students learn the various approaches to statistical learning.</td>
<td>The instructor will assess learning outcome 1 through projects, homework, midterm exam, and final exam for all graduate students in the class. The expectation is that 80% of the graduate students perform at a satisfactory level.</td>
</tr>
</tbody>
</table>

How does this course align with the student learning outcomes articulated for the major, program, or general education? What program-level outcome or outcomes does it support? Is the content or skill introduced, reinforced, or demonstrated in this course?

The first three learning outcomes are the mathematics program learning outcomes.
VII. IMPACT ON EXISTING PROGRAMS and COURSES: Please briefly document the impact and expected changes of this new/changed/deleted course on other departments, programs and courses: if deleting a course—list all departments and programs that include the course; if adding/changing a course—explain any overlap with existing courses in the same or different departments; if adding or deleting a course that will be part of a joint program identify the partner institution.

None are anticipated, since we have been offering Statistical Learning II as a graduate topics course co-listed with Math 441 for the past two years and other than enrollments being more acceptable, there has not been a noticeable impact on anything else.

VIII. COSTS ASSOCIATED WITH THE ACTION REQUESTED: List all of the new costs or cost savings, (including new faculty/staff requests, library or equipment, etc.) associated with the action requested. New courses requiring additional resources will need special justification.

None, since we already offer Math 441 and Math 541 would be co-listed.
IX. APPROVAL AND SIGNATURES

Signature of Program Director: 

Date: 2/9/13

Signature of Department Chair: 

Date: 2/4/13

Signature of Additional Chair*: 

Date: 

Signature of Schools’ Dean: 

Date: 2/7/13

Signature of Additional Schools’ Dean*: 

Date: 

Signature of the Provost: 

Date: 2/15/13

Signature of Budget Director/Business Affairs Office: 

Date: 

*For interdisciplinary courses

Return form to the Graduate School Office for Further Processing

Signature of Chair of the Faculty Committee on Graduate Education, Continuing Education & Special Programs: 

Date: 2/28/2013

Signature of Chair of the Graduate Council: 

Date: 3/18/13

Signature of Faculty Senate Secretary: 

Date: 

Date Approved by Faculty Senate: 

Page 6
STATISTICAL LEARNING II
MATH 441
SPRING 20xx

Instructor: James E. Young
Office: RSS 323
Phone: 953-7295
E-mail: youngji@cofc.edu
Office Hours: Tue and Thu 9:15 – 10:45


Method of Teaching: Lecturing including active learning.

Grading:

Homework (due weekly in class) (20%)

First Midterm (Month day) (20%)

Second Midterm (Month day) (20%)

Project (due Month day) (20%)

Final Exam (Month day) (20%)

Grading Scale
A is 90 or above; A- is 87 to 89; B+ is 84 to 86; B is 80 to 83; B- is 77 to 79; C+ is 74 to 76; C is 70 to 73; C- is 67 to 69; D+ is 64 to 66; D is 60 to 63; D- is 59; F is 58 and below.

Course Objectives: Students will learn the various approaches to statistical learning.

Learning Outcomes

1. Students learn the various approaches to statistical learning.

2. Using statistical methods, students model phenomena in mathematical terms.

3. Using statistical methods, students derive correct answers to challenging questions by applying the models from Learning Outcome 1.

4. Students write complete, grammatically and logically correct arguments to prove their conclusions.
<table>
<thead>
<tr>
<th>Date</th>
<th>Topics</th>
<th>Text Sections</th>
</tr>
</thead>
<tbody>
<tr>
<td>xx/xx</td>
<td>Introduction and motivation</td>
<td></td>
</tr>
<tr>
<td>xx/xx</td>
<td>Broad review and highlights of MATH440: Statistical Learning I</td>
<td></td>
</tr>
<tr>
<td>xx/xx</td>
<td>Oecam’s razor and algorithmic complexity</td>
<td></td>
</tr>
<tr>
<td>xx/xx</td>
<td>Minimum description length (MDL) principle</td>
<td></td>
</tr>
<tr>
<td>xx/xx</td>
<td>Nearest neighbor procedures</td>
<td></td>
</tr>
<tr>
<td>xx/xx</td>
<td>Nearest neighbor procedures continued</td>
<td></td>
</tr>
<tr>
<td>xx/xx</td>
<td>Vapnik-Chervonenkis (VC) dimension</td>
<td></td>
</tr>
<tr>
<td>xx/xx</td>
<td>VC dimension continued</td>
<td></td>
</tr>
<tr>
<td>xx/xx</td>
<td><strong>FIRST MIDTERM</strong></td>
<td></td>
</tr>
<tr>
<td>xx/xx</td>
<td>Biological motivation of neural networks</td>
<td></td>
</tr>
<tr>
<td>xx/xx</td>
<td>Learning neural networks via gradient descent</td>
<td></td>
</tr>
<tr>
<td>xx/xx</td>
<td>Neural network architecture</td>
<td></td>
</tr>
<tr>
<td>xx/xx</td>
<td>Computational complexity limitations to learning neural networks</td>
<td></td>
</tr>
<tr>
<td>xx/xx</td>
<td>Estimating VC dimension of neural networks</td>
<td></td>
</tr>
<tr>
<td>xx/xx</td>
<td>Introduction to support vector machines</td>
<td></td>
</tr>
<tr>
<td>xx/xx</td>
<td>Support vector machines for classification</td>
<td></td>
</tr>
<tr>
<td>xx/xx</td>
<td>Support vector machines for regression</td>
<td></td>
</tr>
<tr>
<td>xx/xx</td>
<td>Generalization capabilities of support vector machines</td>
<td></td>
</tr>
<tr>
<td>xx/xx</td>
<td><strong>SECOND MIDTERM</strong></td>
<td></td>
</tr>
<tr>
<td>xx/xx</td>
<td>Generalization error bounds for support vector machines</td>
<td></td>
</tr>
<tr>
<td>xx/xx</td>
<td>Structural risk minimization induction</td>
<td></td>
</tr>
<tr>
<td>xx/xx</td>
<td>PAC learning paradigm</td>
<td></td>
</tr>
<tr>
<td>xx/xx</td>
<td>Unsupervised learning</td>
<td></td>
</tr>
<tr>
<td>xx/xx</td>
<td>Feature selection/extraction</td>
<td></td>
</tr>
<tr>
<td>xx/xx</td>
<td>Self-organizing maps</td>
<td></td>
</tr>
<tr>
<td>xx/xx</td>
<td>Boosting and bagging in classification and regression</td>
<td></td>
</tr>
<tr>
<td>xx/xx</td>
<td>Boosting and bagging in classification and regression continued</td>
<td></td>
</tr>
<tr>
<td>xx/xx</td>
<td>Course review: <strong>PROJECT DUE</strong></td>
<td></td>
</tr>
<tr>
<td>xx/xx</td>
<td><strong>FINAL EXAM</strong></td>
<td></td>
</tr>
</tbody>
</table>

Note: This schedule is meant as a guide. Some sections or subsections may be omitted depending on availability of time and/or superceding priorities. Any deviations from this schedule will be announced in advance.
Note: This schedule is meant as a guide. Some sections or subsections may be omitted depending on availability of time and/or superceding priorities. Any deviations from this schedule will be announced in advance.

**Class attendance policy:** Every student is expected to attend every class. If extreme circumstances necessitate an absence, get the notes and assignment from a classmate or see me. You are responsible for making up any missed work. Four or more absences from the class will result in a grade of WA (See p. 18 of the Undergraduate Catalog for more information). I encourage you to see me with any problems you may have, either during my office hours, or make an appointment to see me at another time if your work schedule conflicts.

**Honor Code and Academic Integrity:** (language provided by the Dean of Students)

Lying, cheating, attempted cheating, and plagiarism are violations of our Honor Code that, when identified, are investigated. Each instance is examined to determine the degree of deception involved.

*Incidents where the professor believes the student’s actions are clearly related more to ignorance, miscommunication, or uncertainty, can be addressed by consultation with the student. We will craft a written resolution designed to help prevent the student from repeating the error in the future. The resolution, submitted by form and signed by both the professor and the student, is forwarded to the Dean of Students and remains on file.*

Cases of suspected academic dishonesty will be reported directly to the Dean of Students. A student found responsible for academic dishonesty will receive a XF in the course, indicating failure of the course due to academic dishonesty. This grade will appear on the student’s transcript for two years after which the student may petition for the X to be expunged. The student may also be placed on disciplinary probation, suspended (temporary removal) or expelled (permanent removal) from the College by the Honor Board.

*It is important for students to remember that unauthorized collaboration—working together without permission—is a form of cheating. Unless a professor specifies that students can work together on an assignment and/or test, no collaboration is permitted. Other forms of cheating include possessing or using an unauthorized study aid (such as a PDA), copying from another’s exam, fabricating data, and giving unauthorized assistance.*

*Remember, research conducted and/or papers written for other classes cannot be used in whole or in part for any assignment in this class without obtaining prior permission from the professor.*

*Students can find a complete version of the Honor Code and all related processes in the Student Handbook.*

**Students with Disabilities**

If you have a learning disability that will affect your performance in this class, you should contact Disability Services (953-1431) and talk to me in private. I can make no special testing allowances without documentation from Disability Services. Appointments with Disability Services for alternate testing must be made by the student at least three days in advance of the test.
GRADUATE PERMISSION TO CROSS-LIST FORM

This form must ALWAYS be accompanied by a graduate COURSE FORM.

Contact Name: Robert Mignon
Email: mignonr@cofc.edu
Phone: 5740

Department and School Name: Mathematics in SSM
Name and Acronym of Graduate Program: Master of Science in Mathematics

Date (Semester/Year) cross-listing will take effect: Spring 2014

I. CATEGORY OF REVIEW (Check all that apply)

X New Course -- Course Number/Title MATH 541 Statistical Learning II
☐ Existing Course -- Course Number/Title
☐ Special Topic Course -- Course Number/Title

This course will be cross-listed with an

X undergraduate course (complete sections II, III, and IV below) MATH 440 Statistical Learning II
☐ existing graduate course (complete section IV below)

II. CURRICULUM DIFFERENCES -- UNDERGRADUATE AND GRADUATE LEVELS

Please submit separate syllabi for both graduate and undergraduate courses

Syllabi for both undergraduate and graduate courses are attached  x YES  ☐ NO

Explain the differences between the syllabi in terms of requirements, learning objectives and course content

The learning objectives are the same, but the expectations for the graduate course will be higher. Typically there will be extra exam questions and additional projects appropriate for graduate level work. The course objectives and learning outcomes will be the same for Math 441 and Math 541, with a higher level of performance expected for graduate students, especially for learning outcome 3 Students write complete, grammatically and logically correct arguments to prove their conclusions. Graduate students will be expected to perform at an appropriate level.
III. APPROVAL SECTION – GRADUATE COURSE WITH UNDERGRADUATE COURSE

Undergraduate Course Number / Title   MATH 441 Statistical Learning II

Names and Signatures:

Name of Department Chair of the Graduate Course  Robert Mignone

Signature ____________________________ Date: 2/14/2013

Department Chair of the Undergraduate Course  Robert Mignone

Signature ____________________________ Date: 2/14/2013

Graduate Program Director  Ben Cox

Signature ____________________________ Date: 2/14/2013

Dean  Michael Auerbach

Signature ____________________________ Date: 2/7/13

Provost  George Hynd

Signature ____________________________ Date: 2/15/13

IV. APPROVAL SECTION – GRADUATE COURSE WITH EXISTING GRADUATE COURSE

Graduate Course Number / Title of Existing Graduate Course

Program(s) of Existing Graduate Course

Names and Signatures:

"Host” Program Director

Signature ____________________________ Date: ________________

"Requesting” Program Director

Signature ____________________________ Date: ________________

Provost

Signature ____________________________ Date: ________________
Return form to the Graduate School Office for Further Processing

Signature of Chair of the Faculty Committee on Graduate Education, Continuing Education & Special Programs:

[Signature]

Date: 2/28/2013

Signature of Chair of the Graduate Council:

[Signature]

Date: 3/18/13

Signature of Faculty Senate Secretary:

[Signature]

Date: 

Date Approved by Faculty Senate: 

September 2011
Hi Bob,
Registrar’s Office staff are reviewing the graduate Math proposals and we have a question:
The new course proposal for MATH 540 says that prerequisites will be MATH 203, MATH 220 and MATH 350. We do not normally list CofC undergraduate courses as prerequisites for graduate courses since the graduate students may not have attended CofC. The actual prereq is normally set as “Permission of the Instructor”. Is this satisfactory and, if we handle it this way? Would you like to say the prerequisite is permission of the instructor but that students should have had the equivalent of ..........? This information could be written in the catalog but only Permission of instructor will be coded in Banner.
Thanks,
Cathy